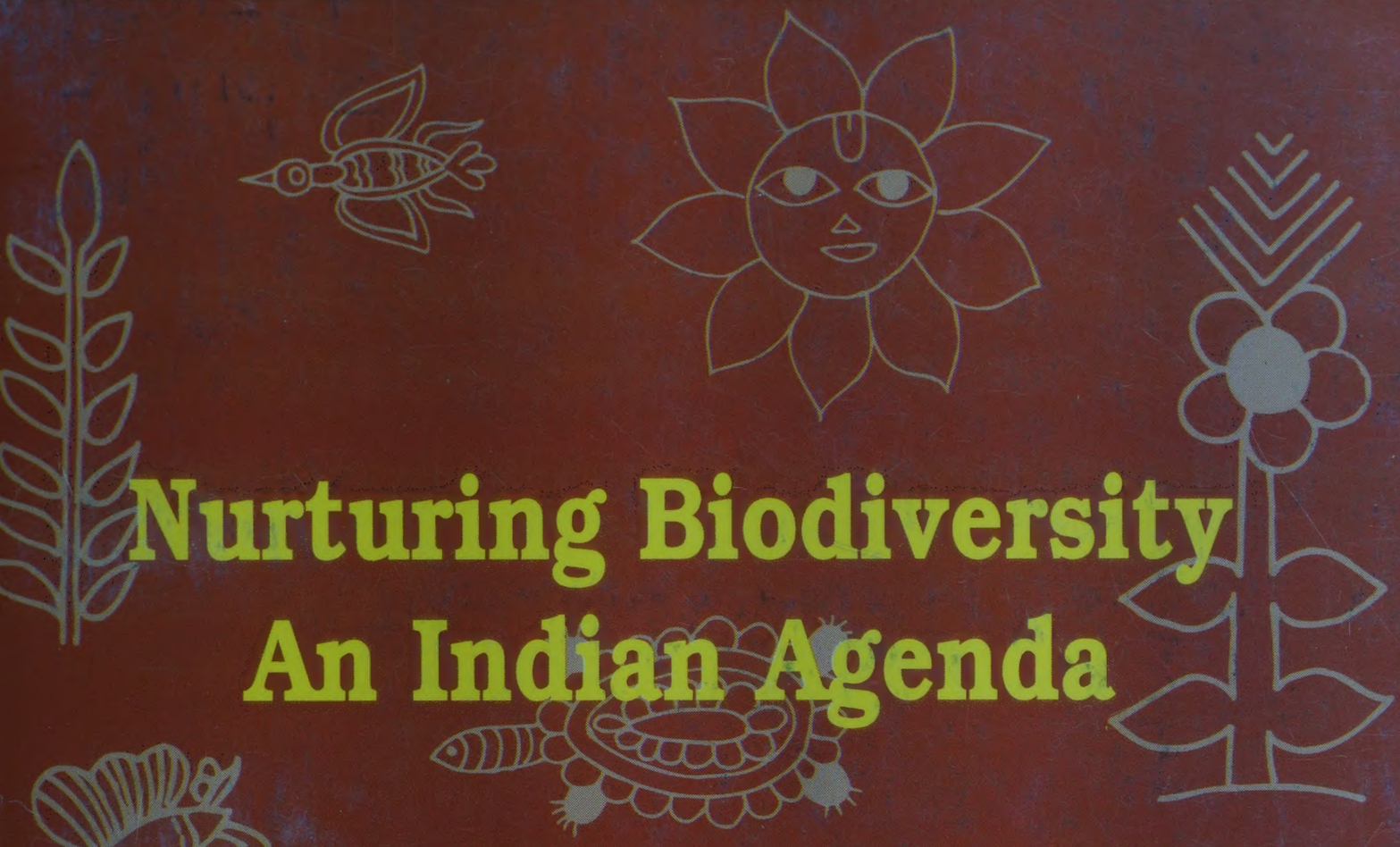
Environment and Development Series



Nurturing Biodiversity
An Indian Agenda

Madhav Gadgil
and
P. R. Seshagiri Rao

Centre for Environment Education

11657
CLIC
SOPHEA

SOCHARA
Community Health
Library and Information Centre (CLIC)
Community Health Cell
85/2, 1st Main, Maruthi Nagar,
Madiwala, Bengaluru - 560 068.
Tel : 080 - 25531518
email : clic@sochara.org / chc@sochara.org
www.sochara.org

951-

Environment & Development Series

COMMUNITY HEALTH CELL

Library and Information Centre

No. 367, Srinivasa Nilaya, Jakkasandra,
I Main, I Block, Koramangala, Bangalore - 560 034.

THIS BOOK MUST BE RETURNED BY THE DATE LAST STAMPED		

Also available:

Sustainable Development in Fragile Environments, *N.S. Jodha*

Sustainable Technology: Making the Sardar Sarovar Project Viable, *Suhas Paranjape* and *K.J. Joy*

Waste Minimization: A Practical Guide to Cleaner Production and Enhanced Profitability, *Prasad Modak*

Joint Forest Management: The Haryana Experience, *Madhu Sarin*

Banking on Biomass: A New Strategy for Sustainable Prosperity Based on Renewable Energy and Dispersed Industrialization, *K.R. Datye*

Minding Our Marine Wealth: An Appraisal of Gujarat's Coastal Resources, *N.D. Chhaya*

Nurturing Biodiversity
An Indian Agenda

Madhav Gadgil*, #

and

P.R. Seshagiri Rao*

* Centre for Ecological Sciences
Indian Institute of Science
Bangalore 560 012

and

Jawaharlal Nehru Centre for Advanced Scientific Research
Jakkur P.O., Bangalore 560 065
Telephone: (91-80) 3315453, 3340985, 3092507
Fax: 91-80-3315428, 3341683
E-mail: madhav@ces.iisc.ernet.in

Centre for Environment Education
Ahmedabad

The **Environment and Development Book Series Project** is funded by the Swiss Development Cooperation, the Ford Foundation and the Centre for Environment Education (CEE). CEE is a national institute established in 1984 and supported by the Government of India, Ministry of Environment and Forests.

Project Committee	: Kartikeya V. Sarabhai, Kiran Desai, Bipin Shah, Prithi Nambiar
Project Coordinator	: Prithi Nambiar
Project Assistant	: Preeti Ramesh, Priya Padmanabhan
Series Design	: D.M. Thumber
Lay out	: Balamani R. Menon
Diagrams	: Balamani R. Menon, D.M. Thumber
Illustrations	: Mukesh Barad
Support Services	: V. P. Aan, Snehal Bhatt, Leena Mehta
Cover Design & Production	: D.M. Thumber

© 1998, Centre for Environment Education
All rights reserved

ISBN 81-86385-13-4

Published by the Centre for Environment Education, Nehru Foundation for Development, Thaltej Tekra, Ahmedabad 380 054.

Special price Rs. 95

US $ 21

11657
E-100 N98

COMMUNITY HEALTH CELL
LIBRARY
and
Information
Centre

For Kailash Malhotra
Friend, Philosopher, Guide
In celebration of two decades of collaboration

Foreword

In India, we are going through the process of trying to integrate environmental parameters into decision making for more holistic and sustainable strategies of development. The Centre for Environment Education is concerned with bringing information relating to more innovative strategy within the reach of the policy makers, in order to sensitize them to the need for environmentally sound decisions. The current book series has been planned as a means of providing access to alternative viewpoints, backed by analysis and information, on various policy aspects presented by development theorists and practitioners from diverse fields.

The escalating rate of erosion of biodiversity in India which is one of the top twelve megadiversity countries in the world, is a cause for grave concern. It has become imperative to convey to policymakers the need to address this problem with the utmost urgency. India has a long history of conserving its natural heritage. This conservation was not self consciously done. It was not a separate "initiative", but an integral part of the way people lived and worked, a part of India's culture. However, the prevalent model of management which makes conservation a government initiative rather than a popular one, and in fact treats local communities as the "problem" rather than the "solution", is fundamentally flawed. This, our final book of the first phase of the environment and development series, critiques the existing scenario by identifying the systemic constraints that have enabled and indeed hastened this deterioration of ecological health and goes on to outline a strategy that could help reverse this process.

The strategy envisaged stresses the need for equity considerations and large scale involvement of the people in the management of our natural resources. It suggests that the popular application of scientific methods combined with an understanding of the economic potential offered by biotechnological advancement, could yield a potent formula for an ecologically sound approach to the future.

The authors believe that participation in a global economy is inevitable and recommend an energetic and pro-active response that mobilizes our enormous

technical and scientific resources of trained manpower, integrates our traditional sciences with modern fast science, enhances the role that could be played by the grama sabha at the grassroots and bargains for better terms of trade in the international arena in this holistic and uniquely Indian approach to the environmental challenge of our times.

Kartikeya V. Sarabhai
Director
Centre for Environment Education

Contents

	Page no
1. Reckoning with Life	1
1.1 On the threshold	
1.2 New regimes	
1.3 Practical ecological knowledge	
2. Science—Fast and Slow	13
2.1 Putting information to good use	
2.2 Slow science of Ayurveda	
2.3 Fast science of Allopathy	
2.4 Standardizing names	
2.5 What is new knowledge?	
2.6 Lack of methodology of validation	
2.7 Sharing information	
2.8 Health care	
3. Conservation or Confiscation?	24
3.1 How 'scientific' is our management of natural systems?	
3.2 Ecosystem people versus omnivores	
4. The Iron Triangle	30
4.1 Perverse incentives	
4.2 Bamboo: A case study	
4.3 Condemning traditions	
5. Conservation Initiatives	38
5.1 Parks and sanctuaries	
5.2 An elitist approach	
5.3 Disturbance and diversity	
5.4 Sacred sites	
5.5 Keystone species	
6. Our Weaknesses	46

7. Environment and the National Agenda 49
7.1 Emerging objectives
7.2 Efficiency and equity
7.3 A broad spectrum approach
8. Custodians of Diversity 54
8.1 Involving people
8.2 Promoting larger interests
8.3 Social justice
9. Governing the Commons 57
9.1 Outstanding questions
9.2 Designing alternative institutions
9.3 An integrated approach
9.4 Supply and safety regimes
9.5 Rights and role of the local community
9.6 Primary health care
9.7 Education and information systems
10. Spelling Out a Framework 62
10.1 Role of *grama sabha*
10.2 State and national level institutions
10.3 Re-defining the role and powers of government agencies
10.4 Legal support
10.5 Managing funds
10.6 Ingredients of success
10.7 Setting conservation priorities
10.8 Formulating appropriate incentives
11. The International Context 73
11.1 No longer a common heritage
11.2 Sovereign property
12. Protecting Our Interests 82
12.1 A promotional approach
12.2 North-south co-operation
12.3 Defining biodiversity resources

13. Specifications—IPR and Country of Origin 86
13.1 Mandatory disclosure
13.2 Distribution patterns of living organisms
13.3 Dispersals
13.4 Defining country of origin
14. A Global Framework 92
14.1 Clearing house facility
14.2 Biodiversity conservation fund
14.3 Country shares
15. Enhancing Indigenous Capabilities 97
15.1 Strengths of MNCs
15.2 Turmeric and neem: Two approaches
15.3 Material transfer agreements
15.4 Protecting people's rights
15.5 People's biodiversity registers
16. Biodiversity Information Systems 103
16.1 Multiple forms of information
16.2 Organizing a service industry
16.3 Biodiversity data banks today
16.4 Need for a comprehensive system
17. Meeting the Challenge 107
17.1 Harnessing practical ecological knowledge
17.2 Training barefoot ecologists
17.3 Organizing a scientific biodiversity information system
17.4 Documentation by student-teacher teams
17.5 People's environment registers
18. Biodiversity Cells—Structure and Financing 138
18.1 Structure and management
18.2 Self financing—ways and means
18.3 Problems with royalty payments
19. Role of Panchayats 141
19.1 Decentralising natural resource management
19.2 Special grants and awards

20. In Tune with the Times 148
20.1 Growth with equity
20.2 Moving away from exclusion
20.3 Rejecting leaky patronage
20.4 State as a catalyst with accountability
Suggested Reading 153
Index 157

1
Reckoning with Life

1.1 On the threshold

We live in exciting times, times of unprecedented challenges, opportunities and dangers. All around us the world is changing faster than ever before. The principal driving force behind these changes is technology, technology that is now moving the world from an age of industry into one of information. These developments have fuelled a rapid growth in the world economy and in human populations over the last fifty years; developments that have exacted their toll in terms of degradation of the environment. Perhaps the most significant of all environmental issues is that of erosion of biological diversity. It is feared that as many as 10 per cent of all species of living organisms may go extinct over the next decade or two. This genetic erosion has serious economic implications as well, for over the last fifty years the tremendous progress in biotechnologies has opened up entirely new avenues of opportunities for commercial applications of biological diversity.

With numerically the third largest scientific and technical manpower and rated one of the twelve top megadiversity countries in the world, India ought to be well placed to face new challenges, and reap benefits from new opportunities. Unfortunately we are very poorly equipped to do so. Over fifty years of independence, we have not only failed to develop our human resources but also squandered away our natural resources. Today, India harbours a larger number of illiterates than ever before. Our scientific-technical establishment has few links with the industrial sector which continues to rely almost totally on imported technologies. We have a very poor base of information on our natural resources. Deforestation, desertification, waterlogging and salination and many forms of chemical pollution wreak havoc with our environment. Evidently we need a new culture, new institutions to take good care of our human and natural resources. This new culture, these new institutions have to be appropriate to the new age of information. This requires that we embrace a new democratic culture of inform and share, eschewing the current bureaucratic

culture of control and command. At the same time, we must create a stake for the people in taking good care of the natural resource base. We must awaken in people the spirit of innovation and enterprise to marry the rich traditional knowledge base with modern science and to capitalize on our wealth of genetic resources.

The purpose of this book is to argue that such change is not only desirable, but feasible. Indeed there are many signs that we are moving in the right direction. These include the growing strengths of institutions of participatory management of natural resources such as village forest committees, of decentralized governance such as Panchayat Raj institutions, and of programmes such as the literacy mission. It is now up to us to build further on these foundations.

1.2 New regimes

The second half of the twentieth century has witnessed a veritable revolution in life sciences, a revolution that has opened up the possibilities of fabrication of entirely new forms of life. Such technical breakthroughs have led to the realization that many seemingly insignificant creatures might provide clues to the development of products of considerable economic value. Thus an unusual species of frog brooding young in its own stomach might be the key to a new drug against ulcers, and a bacterium living in a hot spring might provide a key enzyme for making multiple copies of genes. Several such applications are already in place, many others are expected to follow and play a major role in the world economy in years to come. Diversity of life will constitute the raw material for these developments. There is therefore tremendous interest in access to and control over this raw material, as well as the newly emerging technologies.

These interests have triggered two new developments, namely, establishment of intellectual property rights over living organisms and their products, and recognition of sovereign rights of nation states over their biological resources. In a world rapidly drawing together two recent international conventions, the Trade Related Intellectual Property Rights (TRIPS) component of the General Agreement on Tariffs and Trade (GATT) and the Convention on Biological Diversity (CBD) have formalized these regimes (Box 1: Agreement on Trade

Box 1

Agreement on Trade-related Aspects of Intellectual Property Rights, including Trade in Counterfeit Goods

Members,

Desiring to reduce distortions and impediments to international trade, and taking into account the need to promote effective and adequate protection of intellectual property rights, and to ensure that measures and procedures to enforce intellectual property rights do not themselves become barriers to legitimate trade:

Recognizing, to this end, the need for new rules and disciplines concerning:

The provision of adequate standards and principles concerning the availability, scope and use of trade-related intellectual property rights:

Recognizing the underlying public policy objectives of national systems for the protection of intellectual property, including developmental and technological objectives;

Hereby agree as follows:

Section 5: Patents

Article 27

Patentable Subject Matter

1. Subject to the provisions of paragraphs 2 and 3 below, patents shall be available for any inventions, whether products or processes, in all fields of technology, provided that they are new, involve an inventive step and are capable of industrial application. Subject to paragraph 4 of Article 65, paragraph 8 of article 70 and paragraph 3 of this Article patents shall be available and patent rights enjoyable without discrimination as to the place of invention, the field of technology and whether products are imported or locally produced.
2. Members may exclude from patentability inventions, the prevention within their territory of the commercial exploitation of which is

necessary to protect *ordre public* or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment, provided that such exclusion is not made merely because the exploitation is prohibited by domestic law.

3. Members may also exclude from patentability:

   (a) diagnostic, therapeutic and surgical methods for the treatment of humans or animals;

   (b) plants and animals other than microorganisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes. However, Members shall provide for the protection of plant varieties either by patents or by an effective sui generis system or by any combination thereof. The provisions of this sub-paragraph shall be reviewed four years after the entry into force of the Agreement Establishing the MTO.

Related Aspects of Intellectual Property Rights, including Trade in Counterfeit Goods and Box 2: Convention on Biological Diversity, preamble, Articles 1 and 2). India is willy nilly being drawn into the folds of these developments, though unfortunately, we are ill prepared for them. India is one of the world's megadiversity countries ranking between ten and twelve in terms of the variety of species (Box 3: World maps of diversity levels). It is also a biomass based civilization in more ways than one. A vast majority of our people earn a livelihood from cultivating the land or rearing cattle, camel, goat or sheep. A good number further depend on biomass gathered with their own labour to cook their meals or thatch their huts. But apart from this gathering, rearing, cultivating, our industrial sector too is heavily dependent on processing of biomass. It is textiles, leather goods, tea, spices and sea food which bring us the bulk of our foreign exchange earnings. With this wealth of biological resources, and having the third largest scientific manpower in the world, India ought to have been well placed to take advantage of the growing significance of biotechnologies in the global economy.

Box 2

Convention on Biological Diversity

PREAMBLE

The Contracting Parties,

Conscious of the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components,

Affirming that the conservation of biological diversity is a common concern of humankind,

Reaffirming that States have sovereign rights over their own biological resources,

Reaffirming also that States are responsible for conserving their biological diversity and for using their biological resources in a sustainable manner,

Concerned that biological diversity is being significantly reduced by certain human activities,

Aware of the general lack of information and knowledge regarding biological diversity and of the urgent need to develop scientific, technical and institutional capacities to provide the basic understanding upon which to plan and implement appropriate measures,

Noting that it is vital to anticipate, prevent and attack the causes of significant reduction or loss of biological diversity at source,

Recognizing the close and traditional dependence of many indigenous and local communities embodying traditional lifestyles on biological resources, and the desirability of sharing equitably benefits arising from the use of traditional knowledge, innovations and practices relevant to the conservation of biological diversity and the sustainable use of its components,

Recognizing also the vital role that women play in the conservation and sustainable use of biological diversity and affirming the need for the full participation of women at all levels of policy-making and implementation for biological diversity conservation,

Stressing the importance of, and the need to promote, international, regional and global cooperation among states and intergovernmental organizations and the non-governmental sector for the conservation of biological diversity and the sustainable use of its components,

Acknowledging that the provisions of new and additional financial resources and appropriate access to relevant technologies can be expected to make a substantial difference in the world's ability to address the loss of biological diversity,

Acknowledging further that special provision is required to meet the needs of developing countries, including the provision of new and additional financial resources and appropriate access to relevant technologies,

Determined to conserve and sustainably use biological diversity for the benefit of present and future generations,

Have agreed as follows:

Article

1

Objective

The Objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.

Article

2

Use of Terms

For the purposes of this Convention:

Biological diversity means the variability among living organisms from all sources including, *inter alia,* terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Biological resources includes genetic resources, organisms or parts thereof, populations, or any other biotic components of ecosystems with actual or potential use or value for humanity.

Biotechnology means any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use.

Country of origin of genetic resources means the country which possesses those genetic resources in *in-situ* conditions.

Country providing genetic resources means the country supplying genetic resources collected from *in-situ* sources, including populations of both wild and domesticated species, or taken from *ex-situ* sources, which may or may not have originated in that country.

Domesticated or cultivated species means species in which the evolutionary process has been influenced by humans to meet their needs.

Ecosystems means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.

Ex-situ conservation means the conservation of components of biological diversity outside their natural habitats.

Genetic material means any material of plant, animal, microbial or other origin containing functional units of heredity.

Genetic resources means genetic material of actual or potential value.

Habitat means the place or type of site where an organism or population naturally occurs.

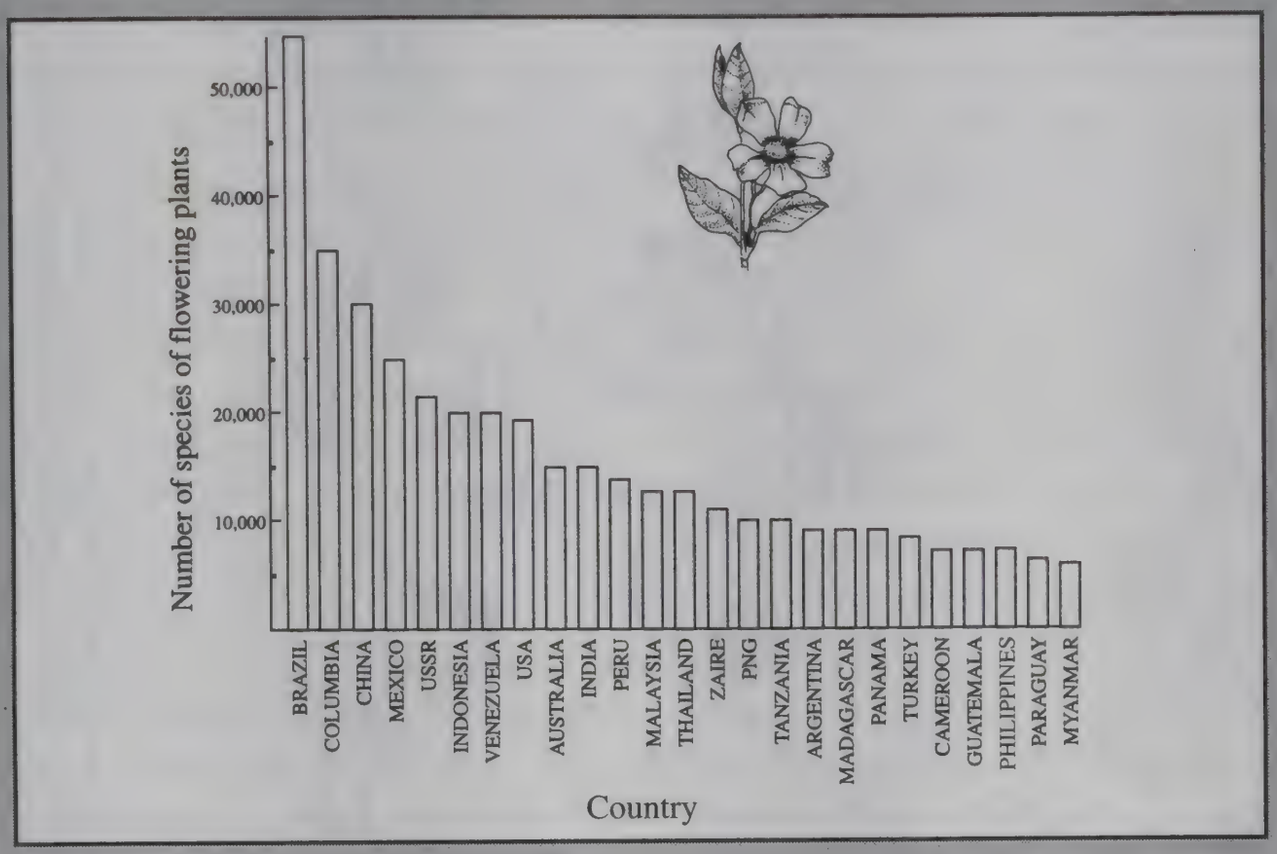
In-situ conditions means conditions where genetic resources exist within ecosystems and natural habitats, and, in the case of domesticated or cultivated species in the surroundings where they have developed their distinctive properties.

Sustainable use means the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

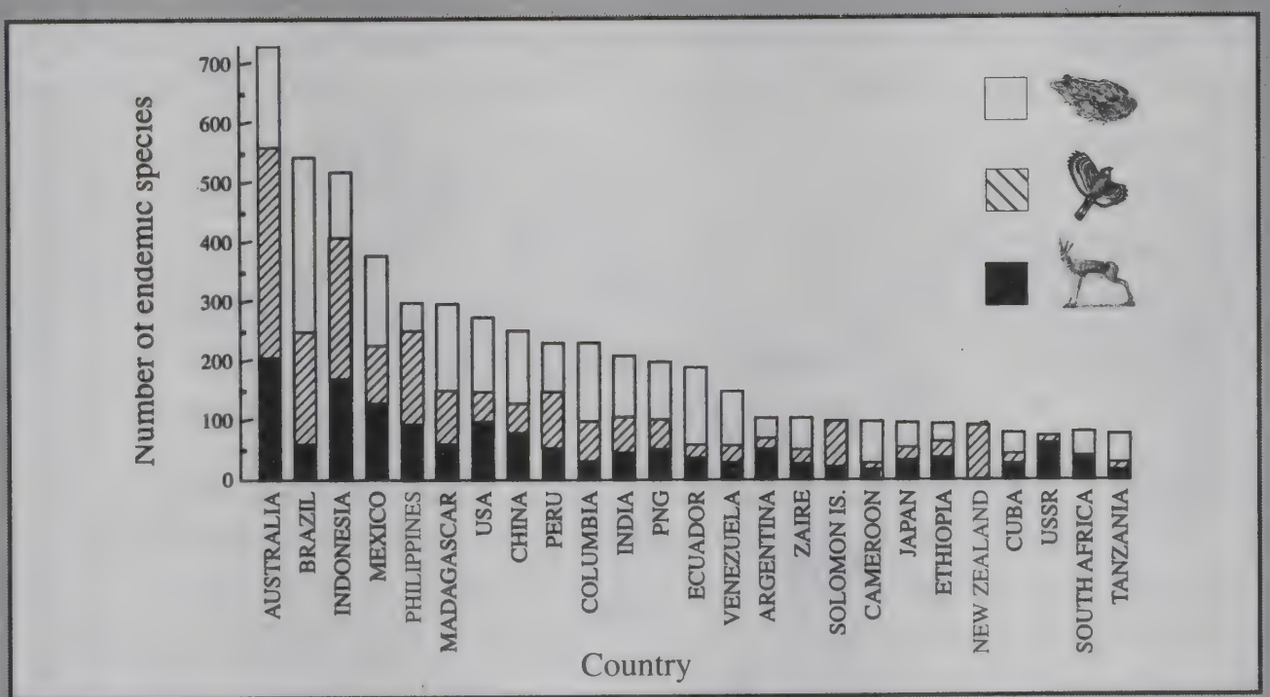
Technology includes biotechnology.

Unfortunately, we are far from such a position of strength. Although successive Indian Governments have strongly supported our science and technology establishment, the latter has by and large failed to address social needs. It has no tradition of serving industry, which has been importing technologies wholesale, in years before and after liberalization. So in an era in which technological innovation is the key to success, Indian industry is competitively in a very weak position. Nor has our scientific establishment helped promote conservation and sustainable use of natural, living or non-living resources. Indeed the so-called scientific management of our forest, water and other natural resources is nothing but a myth. The touchstone of science is its secure contact with facts of the real world. But our natural resource managers are equipped with hardly any information —whether it be of dynamics of forest trees or seismic impacts of water bodies. They are content to use their bureaucratic authority to push through their management plans, based on very inadequate data, and often drawn up to serve some vested interests. When the plans fail, as in the case of the exhaustion of bamboo resources due to bad planning or the failure to deliver promised quantities of water from dams to command areas, the managers blame the farmers, the shepherds and the politicians.

Box 3



Brazil with its extensive tracts of tropical rain forests leads the world, while India ranks 10th in the total number of flowering plants.



The island continent of Australia leads the world, while India ranks 11th in the total number of endemic species of amphibians, birds and mammals.

Biological treasure troves. Eighteen hot spots have been identified as regions on land that harbour a large number of species exclusive to the region and in great danger of extinction from human activities. This identification is however far from complete, and focuses on forests and Mediterranean scrublands and leaves out lakes, rivers and coral reefs. The Indian subcontinent includes two of these hot spots; namely, Western Ghats and Eastern Himalaya.

1.3 Practical ecological knowledge

But it is now becoming increasingly clear that centralized rigid, bureaucratic regimes are quite inappropriate to the management of complex natural systems. Such systems exhibit behaviour highly variable from locality to locality, from time to time and are therefore most efficiently managed in a flexible fashion on the basis of locality specific information. A great deal of such information resides with local fisherfolk and shepherds, forest produce gatherers and farmers who absorb it in the course of daily pursuit of their livelihoods. Very little of this information is available with centralized bureaucracies. Technocracies would, of course, be at an advantage if the science of ecology had equipped them with universal principles that could be effectively applied at the ground level. But ecology has no such principles to offer. Local communities with their detailed locality-specific information, acting on simple rules of thumb, are therefore in as strong a position as any other agency to prudently manage local living resources. They are often better motivated to do so as well, since it is the local people who suffer, most directly, the consequences of the degradation of the local environment.

The value of the knowledge and traditional practices of local communities is now being acknowledged. Many pharmaceutical companies are actively engaged in tapping the local knowledge of medicinal properties of plants. Local communities are being involved in managing natural resources through institutions such as water users' groups in command areas of irrigation projects, or through forest protection committees. At the global level as well, the Convention on Biological Diversity commits all parties to respect the sustainable use practices and knowledge of indigenous communities and to equitably share with them benefits of commercial uses of elements of biological diversity (Box 4 - Convention on Biological Diversity, Article 8(j)).

It is time then to make serious attempts at developing a symbiotic relationship between scientific knowledge, modern as well as traditional, and practical ecological knowledge of local communities. The resultant rich body of knowledge should serve to promote biodiversity based enterprises, as well as sustainable practices of utilization of the country's living resources. The local communities must be given their due share in the benefits of such resource use and of the value added through the enterprises. This calls for development

Box 4

Convention on Biological Diversity

Article

8

***In-situ* Conservation**

Each Contracting Party shall, as far as possible and as appropriate:

f) Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, *inter alia* through the development and implementation of plans or other management strategies;

j) Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices.

of a mutualistic relationship between the masses in India today excluded from any role in the management of the country's natural resources and the narrow elite of larger landowners and urbanites in the organized industries-services sector that decides on how the country's natural resources are to be used.

Only when the country's scientific community thus forges a positive relationship with our practical ecologists, as well as learns to work closely with industrial enterprise, will it achieve its full potential. This should go hand in hand with further strengthening of grass-roots level democratic institutions empowering people to assume real responsibility for conservation and sustainable use of the country's living resources. These we believe are the key prerequisites for the country to conserve and prosper on the basis of its rich biological and human resources.

2
Science—Fast and Slow

2.1 Putting information to good use

The world is rapidly moving from the industrial to the information age. The internet is in place, linking millions of computers over the earth, facilitating instantaneous transfer and rapid processing of incredible amounts of information. The once secure hold of Governments and of sections of society in positions of power over the flow of information to citizens at large, to enterprises, to rival countries and groups is becoming increasingly tenuous. The advantage now decisively lies with those nations, those enterprises, those people who would not be overconcerned with control, but instead learn to put good information to effective use. In a world confronted with an environmental crisis, informational resources are being increasingly deployed to facilitate more efficient use of material resources. Microprocessors, for instance, now lead to substantial gains in efficiency of fuel use in internal combustion engines. Paper mills are aiming at zero effluent technologies, recycling all their chemical inputs. Prosperous societies of the day are those capable of handling information well, of using resources efficiently, of continually coming up with better and better ways of doing so. This is reflected in their being societies that have the highest levels of gross national product per unit of energy used. Thus, Japan, the world leader in information industry, has amongst the highest levels of economic output per energy input. It is way ahead of the United States on this count; an important factor in its competitive edge over that country. India fares very poorly indeed on this index. Our economic output per unit of energy use is just a few per cent of that of Japan.

In a world drawing ever closer together, becoming ever more competitive, India is being left further and further behind not only by the West, but by our East and Southeast Asian neighbours as well. Our grossly inefficient management of resources both natural and informational, is clearly a key factor underlying our difficulties. If we are then to conserve and prosper on the basis of our rich biological and human resources, we must examine in some

depth why we are today so inefficient in our overall management of natural and informational resources.

2.2 Slow science of Ayurveda

Consider, for instance, the wealth of our medicinal plants and the rich information base on their uses in both folk traditions and formalized systems such as Ayurveda and Yunani. The latter are themselves grounded in folk traditions. Thus, in Charaka Samhita, the Ayurvedic classic, Vaidyas are advised "by knowing from cowherds, tapasvis, forest dwellers, hunters, gardeners and by knowing about their form and properties, learn about herbs and medicinal plants". While the ayurvedic system thus absorbed and to an extent systematized the information on medicinal uses of plants, it has remained in the mode of "slow science". This means that there is only limited specification of what a particular medicinal plant is, what a particular health disorder is, how any given drug is prepared as also only very limited empirical verification of the efficacy of a particular drug in the treatment of any particular disorder. It also means that the total body of information is even today highly fragmented, held in many bits and pieces, by multitudes of individuals, clans or other social groups with little communication with each other. The body of knowledge has therefore grown at a very slow pace. After all, the Ayurvedic practitioners of today still rely on the two thousand five hundred year old texts of Charaka and Sushruta.

2.3 Fast science of Allopathy

The last few centuries have witnessed this slow science of Ayurveda being overtaken by the fast science of Western allopathic medicine. This science is fast—it accrues information at a much greater rate—because it insists on far greater standardization, on more stringent procedures of empirical validation and on more rapid and organized exchange of information. Just as Ayurveda grew by absorbing folk practices, this fast science has grown while absorbing the knowledge base of slow sciences. Part of the discipline of the fast sciences is standardization of the names of living organisms. All human societies, including stone age hunter gatherers name the plants and animals in their own environment. Indeed primitive people living close to nature often have very detailed understanding of the habitat, habits, seasonal behaviour of hundreds of species of plants and animals that either possess use or nuisance value to them.

But the names they give to living organisms are highly variable from one locality to another, as are the particular uses that any species is put to in a particular locality.

Take, as an example, the Amla, or gooseberry *Phyllanthus emblica*, with a geographical range extending over large parts of India, Sri Lanka and Southeast Asia. Over this vast range Amla goes under many different names. Within India itself they include Amla, Aoula, Amlike in Hindi, Avla in Marathi, Amlaki in Bengali, Ambli in Punjabi, Nelli and Ugrikayi in Telugu, Toppi and Nellikai in Tamil, Nellikai in Malayalam and Kannada. Amla is used in many Ayurvedic medicines and Ayurvedic pharmacopoeas or Nighantus use a variety of Sanskrit names for it. These include Adhyanda, Ajada, Ajata, Ajjhada, Amlika, Arjata, Bhuparva, Chorata, Dalaparshini, Hilolika, Jhatamala, Kshetramali, Mahidhotika, Nilolika, Putrashronika, Shiva, Uchchata and Vishvaparni. There is however, little possibility of any confusion in the identity of this well known species. But the story can be very different for many other species employed in Ayurveda. The Sanskrit name Shankhapushpi "a plant with a conch like flower" is apparently applied to at least seven different species, belonging to as many as four different families. It is quite unlikely that these very different plants have similar health effects, yet they are employed (interchangeably) in the preparation of a variety of medicines used in the treatment of a wide range of medical disorders.

2.4 Standardizing names

As the system of fast science was being elaborated in Europe, it became clear that some device was needed to arrive at standard names which could reliably be applied to particular species of living organisms. This need was especially acute when dealing with the rich world of tropical life that the Europeans were beginning to encounter in the early phases of European expansion in the sixteenth and seventeenth centuries. The Europeans were also very interested in the manifold economic uses, including medicinal uses of tropical plants and animals. Thus motivated, Van Rheede, an official of the Dutch settlement at Cochin in Kerala set about systematically collecting information on medicinal uses of plants by Etty Achyuthan and two other local physicians. He organized collections of such plants, wrote down detailed descriptions of their structure, the uses verified by him and devised a system of Latin nomenclature. This

system of naming plants was apparently based on the system used by the Ezhava physicians of Kerala. The text that Van Rheede produced was "Hortus Malabaricus", a work that later inspired Carl Linnaeus to develop his own binomial system of nomenclature. This is a system not just of names, but of a standard procedure of detailed description of the plant or animal or microbe which is to bear that name, and a system of repository of specimens relating to the description.

The science of Ayurveda is not backed by any such system. The names used in the Ayurvedic pharmacopoeas have some descriptive content—Shankhapushpi being a plant with a conch like flower—which is grossly inadequate. It is perhaps a historical accident that a more standardized system was invented not by Ayurvedic practitioners or schools, but by Europeans spreading over the world and continually encountering newer and newer plants and animals. However, Ayurvedic practitioners through well over a century have shown little interest in using this system to put their own knowledge base on a more secure footing. While Indian scholars trained in "fast science" have made some limited attempts at establishing equivalence between the standardized botanical names and the names in Ayurvedic texts, no scholar primarily trained in Ayurveda has attempted to do so. Nor have any of the Indian companies marketing Ayurvedic medicine, some with turnovers of tens of crores of rupees, cared to promote such an effort. This might be an indication of the fact that the "slow" sciences indeed have a different culture, a culture with much less concern for empirical validation of the information base.

The "slow science" of Ayurveda has a different, a more holistic approach towards treatment of ailments. It considers the whole range of symptoms of an unwell person and prescribes a whole set of treatments. In contrast the more reductionist allopathic system identifies very specific disorders - such as hepatitis B or cerebral malaria which afflict many different individuals in common, and then looks for a fully characterized chemical which has a curative effect. Now the "fast" science has developed an elaborate methodology grounded in the science of statistics to establish the existence of such a curative effect. And just as Van Rheede developed the Kerala system of plant nomenclature, practitioners of "fast" science like Barry Bloomberg are taking advantage of the information on curative properties of plants in systems like Ayurveda.

2.5 What is new knowledge?

Barry Bloomberg won a Nobel prize for his role in elucidating how hepatitis B is caused. Imbued with a great interest in finding ways of curing the disease, he undertook a systematic survey of the world literature on traditional cures for jaundice coupled with field work on folk medical practices. On the basis of the information so collected, he identified *Phyllanthus niruri,* a relative of amla, *Phyllanthus emblica* as a possible source of a drug effective against hepatitis B. He then prepared chemical extracts from the plant and screened them for effectiveness against the disease in laboratory animal models. This work enabled him to identify a specific active principle on which he now has a patent.

This development raises several important issues. Many folk practitioners, and many practitioners of "slow" systems including Ayurveda had the knowledge that *Phyllanthus niruri* was effective against jaundice. But they were undoubtedly using *Phyllanthus niruri* against other ailments, as also using several other drugs against jaundice, often in mixtures which were not well defined or standardized. None of the practitioners of these systems had carried out very systematic trials on the efficacy of *Phyllanthus niruri,* certainly no trials fulfilling the requirements laid down by the "fast" science. Basing himself on this rather fuzzily defined information base, Bloomberg has put in considerable further effort leading to a much more defined understanding of the curative efficacy of a particular chemical derived from *Phyllanthus niruri.* He has then established monopolistic rights over this knowledge claimed to be novel and of applied value through being awarded a patent. But an important issue arising from this is : how "novel" is this knowledge?

2.6 Lack of a methodology of validation

Are the statements of folk practitioners or those in Ayurvedic pharmacopeas on the efficacy of *Phyllanthus niruri* against jaundice to be treated as definitive enough information, so that the further work by Bloomberg can be said to add an insufficient level of novel information? The answer could be in the affirmative if we reject the need for rigorous statistical demonstrations of the type demanded by "fast" science. But there has to be some system of demonstrating the efficacy of a particular herbal or other medicine against a particular ailment, even if we reject the highly elaborate, reductionist procedure

of "fast" science. In its absence, we have a very long list of plants effective against an equally long list of ailments, according to some Ayurvedic or folk practitioner or other. But the practitioners of "slow" sciences like Ayurveda have failed to define any alternative methods of validation. Indeed, they do not even seem to recognize the vital need to address this issue which did not, for instance, figure at all in two major Congresses of Traditional Sciences and Technologies of India held in Mumbai and Madras in 1993 and 1995. Knowledge cannot accrue with any degree of confidence and rapidity in the absence of some defined methodology of validation. This again is undoubtedly part of the reason why "slow" sciences are being neglected in a world moving towards the age of information.

2.7 Sharing information

"Fast" science differs from the "slow" not only in the knowledge being specified in as much detail as possible, but also in being accessible so that its validity could be verified by several independent parties. It is therefore knowledge which is largely in the public domain, accessible, at least in theory to all; verifiable, at least in theory, by all. There are of course attempts to establish monopolies over the use of the knowledge as through patent protection. But a patent too is accepted only on the basis of the knowledge being made public through a mandatory requirement of disclosure. So "fast" science has gathered speed by disseminating information widely, and drawing in ever increasing numbers of active contributors. This is not the culture of "slow" science, with much information being held as a monopoly of individual medicinemen who pass it on to only one or a few others at the time of their death, or by a small clan. The texts of Ayurveda, such as Charaka Samhita were, to some extent, widely available, though to an elite familiar with Sanskrit language. But an enormous lore of Ayurvedic practices was, and even today is held by much smaller, regional groups of practitioners and is not readily accessible to the public. There has been no concerted effort to make this more widely available through media such as scientific treatises and journals by the practitioners of "slow" science themselves, although practitioners of "fast" science have attempted to do so through media such as James Watt's century old work on economic products of India.

The printed word is today being fast replaced by electronic databases, and again the practitioners of "fast" science are way ahead. All published information, such as in the Wealth of India series on the recorded medicinal uses of Indian plants is already part of electronic databases such as the Chicago based NAPRALERT (Natural Products Alert). Parallel attempts by organizations such as the Foundation for Revitalization of Local Health Traditions to organize such databases through Indian organizations having barely taken off, these organizations today largely serve to disseminate information being held in an American database.

This failure reflects the Indian culture of putting little value on good information that may be verified by all parties concerned. Instead much information of value is held monopolistically by bureaucratic agencies such as Forest Departments or Botanical Survey of India, who are reluctant to allow access to the information, and greatly resent others pointing out errors in the information held by them. This is why there is essentially no organized information available today on the distribution, levels of abundance, harvests and threats to continued survival of populations of India's medicinal plants. Neither do we have any reliable estimate of the value of their trade, which would run into hundreds of crores of rupees a year.

Not only are medicinal plants and traditional health care based on them, of considerable commercial significance, it is still the most significant form of health care available to very large numbers of Indian people. Estimates suggest that 70 per cent of the Indian population depends on traditional plant based medicines for their health care needs. Results of the People of India project of the Anthropological Survey of India corroborate these figures. This project has assigned the total Indian population to 4752 communities. Of these as many as 3226 still report that they depend on traditional health care systems.

2.8 Health care

Notably enough, people belonging to the communities dependent on traditional health care systems are predominantly tribal, fisherfolk, shepherd, peasant and artisanal populations from rural India. These are also communities who depend on fuelwood or dung as energy sources and on springs and wells for their water supply. Many of them catch fish from these streams as well. These then are the

people who with their own labour meet the bulk of their resource demands from their surroundings or generate them through low input agriculture or livestock rearing. Continuing their traditional intimate dependence on their immediate environment, they are the ecosystem people of India (Box 5: Ecosystem people, omnivores, ecological refugees). These are also the people who gather in the field thousands of tonnes of medicinal herbs that feed our Ayurvedic and Yunani pharmaceutical industry, and are therefore the only repositories of information—widely dispersed and unorganized as this information is—on what is happening to the populations of our medicinal plants. However, they have hardly benefited from India's march towards the twentieth century; indeed many of them have suffered displacement as a consequence of development projects like dams and mining, and have ended up as ecological refugees.

India's health care system, which supplied no less than 36 highly trained specialists to look after the health of our former Prime Minister, Shri P.V. Narasimha Rao on a full time basis, has done little other than eradication of smallpox for this segment of our society. They often have no safe source of drinking water, minimum access to modern medical facilities and face a shrinking base of medicinal plants and knowledge of their uses to take care of their health needs. Diseases that particularly afflict them such as leprosy are still rampant, while tuberculosis and malaria are reappearing. The Indian Council of Medical Research and our fairly prosperous pharmaceutical industry have been indifferent to this segment.

The pharmaceutical industry has, in the meanwhile, been profiting by exploiting the Indian regime of process patents. A process, as opposed to a product patent permits manufacture of a product, such as a drug developed and patented by another company, through a different process. The elaborate regime of testing required for demonstrating the efficacy and safety of a drug on the "fast" science track implies large investments in development of new drugs in countries like USA. Once such a product has been accepted, it takes much less investment to come up with a different process for its manufacture. One of the achievements of the Indian "fast" science establishment has been to develop such processes and make them available to the Indian pharmaceutical industry for commercialization. This has permitted it to be competitive on the international market and make good profits over the last decade. Indeed, it was this competitive

Box 5

Ecosystem People, Omnivores, Ecological Refugees

Dasmann (1988) provides an insightful analysis of the different ways in which people relate to their base of natural resources. He identifies people at the two extremes of what is undoubtedly a continuum as ecosystem people and biosphere people, or, as we have termed them, omnivores. Ecosystem people largely depend on their own muscle power, and that of their livestock to gather, produce and process most of the resources they consume. The bulk of these therefore comes from a limited resource catchment; from an area of around 50 km^2 around their homesteads. Moreover ecosystem people are characteristically linked to their resource catchments over long periods, often several generations. Many tribal, peasant, pastoral and rural artisanal communities of India fit this description. Omnivores, on the other hand, have extensive access to additional sources of energy such as fossil fuels or hydroelectricity. This enables them to transport and transform large quantities of material resources from all over the world for their own use. Hence, their resource catchments are vast. They are continually tapping newer and newer resources, for instance, nuclear power, from newer localities, for instance, drilling for oil in the deeper seas. They are very much part of an increasingly globalising market economy. Most citizens of the First World, and the Third World elite behave as omnivores.

To these two categories of Dasmann, one may add yet one more, that of ecological refugees. Ecological refugees are ecosystem people, deprived of access to their traditional resource base, who are forced to colonize new localities where they continue to depend largely on human and animal muscle power to gather, produce and process resources (Fig. 1). Their resource catchments remain limited, but these are no longer ecosystems with which they have been integrated over generations. They therefore neither have the attachments, nor the knowledge, nor the motivation to use the resources of these new catchments in a prudent fashion. White colonizers of North America were largely such ecological

refugees of the resource crunch that afflicted Europe during the Little Ice Age. So must have been the people who gradually colonized whole series of Pacific islands over the last millennium. Examples of present day ecological refugees include peasants moving into the rain forest of Amazon in Brazil or Western Ghats in India. Another wave of ecological refugees today creates the shanty towns of Third World cities, or lives as illegal, immigrant labour working on farms in the United States.

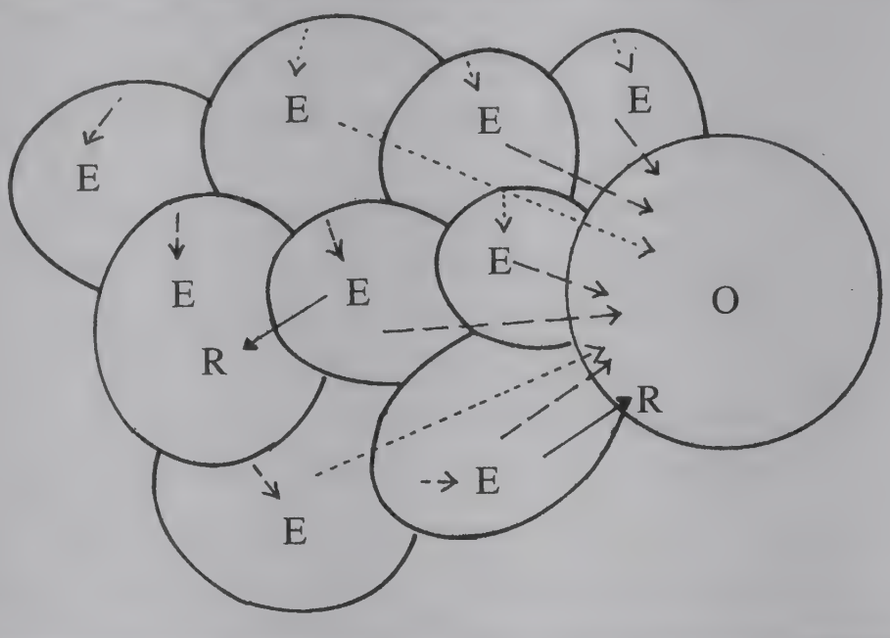


Figure 1 : Schematic representation of fluxes of people and resources. Omnivores (O) organize resource fluxes from over a wide resource catchment. Ecosystem people (E) utilize resources from more restricted catchments. Strong (- - - ->) or weak (.....>) resource fluxes directed towards concentrations of omnivores lead to resource depletions which convert ecosystems people into ecological refugees (R) who either move (⟶) towards areas from which omnivores have not as yet drawn much resources as forest encroachers or towards concentrations of omnivores as urban squatters.

ability of Indian pharmaceutical industry that was in part responsible for countries like USA pushing through the General Agreement on Tariffs and Trade (GATT) with its component agreement on Trade Related Intellectual Property Rights (TRIPS) which makes it mandatory for all countries to accept a product (in place of process) patent regime. Under this regime Indian pharmaceutical industry would soon lose the lucrative market opportunities it had been tapping in recent years.

To sum up then, Indian society has been quite unable to build upon its ancient and rich traditions of health care, to marry the traditions of "slow" science with the positive innovations of the modern "fast" science. Nor has it been able to take advantage of the modern "fast" science to effectively tackle the special health problems of our people—problems like leprosy, tuberculosis and malaria. Rather the contact with "fast" science has merely triggered erosion of the widespread availability of information on the use of local herbal remedies. At the same time there has also been a rapid depletion in the availability of medicinal plants themselves whose harvesting has been totally unregulated and often nonsustainable.

3
Conservation or Confiscation?

3.1 How "scientific" is our management of natural systems?

The country's forestry establishment with its wildlife wing is supposedly in charge of a system of scientific management ensuring sustainable utilization of wild living resources—including most of our medicinal plants. Unfortunately this twofold claim of "scientifically" managing these resources on a "sustainable" basis does not stand up to scrutiny. The touchstone of science is contact with hard facts of the real world. Forestry, fishery, water resource management deal with complex natural systems and with behaviour highly variable in space and time. Few generalizations are possible about the behaviour of these systems, and such generalizations as are available, for instance, that the biological production levels of carnivores (tigers, wolves, mongooses) would be lower than those of herbivores (deer, goats, squirrels) have only limited application to management of specific systems. Good management of such systems therefore calls for continual inputs of very detailed information. Our Forestry and Fishery establishments have an entirely unreliable and inadequate information base even at the grossest level. Thus thirty years ago, the National Commission on Agriculture noted that it was unable to decide whether the total extent of land controlled by the Forest Departments in the various states and union territories of the country was 69 or 75 million hectares. These 69 or 75 million hectares merely refer to land under the legal control of Forest Departments; much of this land has no tree cover whatsoever. The information base on the extent of that tree cover was much weaker. How weak was demonstrated when an independent scientific agency, the Space Department, attempted to estimate the extent of various levels of forest canopy based on satellite imagery. The figures they came up with were far lower than the claims of the Forestry establishment (Table 3.1 : NRSA – Forest Survey estimates). The unfortunate response of the Forestry establishment has been to squash the system of independent assessment of the forest cover by the Space Department, and to take over entirely, the job of interpreting the country's forest cover based on

Table 3.1: Various available estimates of forest area in millions of ha with a canopy cover of 10% provided by the National Remote Sensing Agency and the Forest Survey of India (FSI).

State/ Union territories	Forest cover assessment			
	NRSA's interpretation of landsat data		FSI's 1987 Assessment based on imagery of 1981-83	FSI's 1989 Assessment based on imagery of 1985-87
	1972-75	1980-82		
Andhra Pradesh	4.9049	4.0438	5.0194	4.7911
Arunachal Pradesh	5.1438	5.2104	6.0500	6.8763
Assam	2.1055	1.9796	2.6386	2.6058
Bihar	2.2687	2.0139	2.8748	2.6934
Goa (including Daman & Diu)	0.1221	0.1139	0.1285	0.1300
Gujarat	0.9459	0.5057	1.3570	1.1670
Haryana	0.0757	0.0401	0.0644	0.0563
Himachal Pradesh	1.5075	0.9130	1.2882	1.3377
Jammu & Kashmir	2.2335	1.4361	2.0880	2.0424
Karnataka	2.9480	2.5655	3.2264	3.2100
Kerala	0.8611	0.7376	1.0480	1.0147
Madhya Pradesh	10.8568	9.0215	12.7749	13.3191
Maharashtra	4.0682	3.0350	4.7416	4.4058
Manipur	1.5090	1.3572	1.7679	1.7885
Meghalaya	1.4390	1.2458	1.6511	1.5690
Mizoram	1.3860	1.1971	1.9092	1.8178
Nagaland	0.8154	0.8095	1.4351	1.4356
Orissa	4.8383	3.9425	5.3163	4.7137
Punjab	0.1120	0.0499	0.0766	0.1161
Rajasthan	1.1294	0.5972	1.2478	1.2966
Sikkim	0.1761	0.2883	0.2839	0.3124
Tamil Nadu	1.6676	1.3187	1.8380	1.7715
Tripura	0.6330	0.5138	0.5743	0.5325
Uttar Pradesh	2.5869	2.1022	3.1443	3.3844
West Bengal	0.8347	0.6483	0.8811	0.8394
Andaman & Nicobar Island	0.7294	0.6424	0.7603	0.7624

State/ Union territories	Forest cover assessment			
	NRSA's interpretation of landsat data		FSI's 1987 Assessment based on imagery of 1981-83	FSI's 1989 Assessment based on imagery of 1985-87
	1972-75	1980-82		
Chandigarh	–	–	0.0002	0.0008
Dadra & Nagar Haveli	0.0177	0.0125	0.0237	0.0205
Daman & Diu	–	–	–	0.0002
Delhi	0.0018	0.0010	0.0015	0.0022
Lakshadweep	–	–	–	–
Pondicherry	–	–	0.0008	–

satellite imagery. The information put out by this Forest Department agency, the Forest Survey of India, has rather limited credibility. Certainly our own field verification of the forest maps on 1:250,000 scale prepared by the Forest Survey indicates that they are of a very poor quality and provide little useful information. Instead the forest maps produced by an independent agency, the French Institute in Pondicherry, are far more informative.

The same problem of lack of reliability of information holds true with regard to stocks of particular species, or groups of species. Some years ago while working on a study of the causes of rapid depletion of bamboo stocks of Karnataka state, we examined the estimates of bamboo stocks by the then just concluded Forest Resource Survey of the state, and verified them against sample field checks. The figures of the Forest Resource Survey were found to be gross overestimates, probably by a factor of ten.

The forestry establishment is clearly disinterested in good empirical information. The reason is straightforward: the forestry establishment was created by the British to exclude; to wrest control over the vast common property resources of the country from the local communities and to dedicate them to imperial interests. While this was claimed to be an effort at "conservation", it was really an exercise in "confiscation" as pointed out by

a plain speaking British official of the Revenue Department of Madras Presidency in the 1860's. Of all the wings of the Government, the forestry establishment has perhaps changed the least following independence.

3.2 Ecosystem people versus omnivores

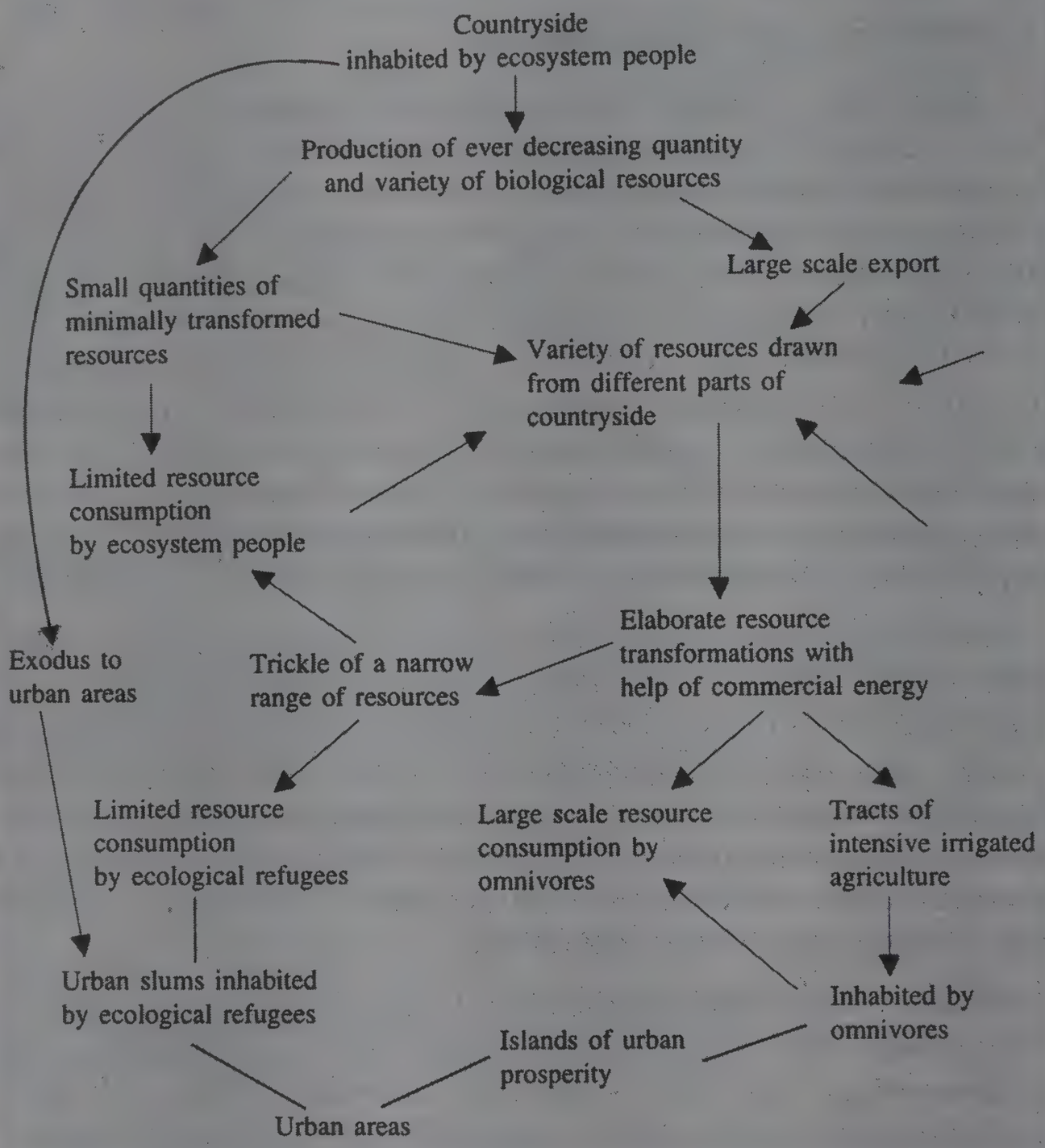
We talked earlier of India's tribals, fisherfolk, shepherds, peasants, rural artisans as ecosystem people, dependent to a great extent on resources they either gather or produce from lands and waters in their immediate environments. Biosphere people, or omnivores as we prefer to call them, form the other major ecological category. These are people who have access through markets to resources over much vaster catchments, perhaps the whole biosphere. They are landlords owning tracts of intensive, irrigated agriculture, and town and city people in the organized industries and services sector. From a human ecological perspective, the entire process of development may be viewed as organizing state sponsored flows of natural resources for the benefit of omnivores, largely at the cost of ecosystem people, often turning them into ecological refugees (Box 6: Organization of Indian society in terms of resource use).

Bamboos, basket weavers and paper mills are a case in point. India's tropical forests are rich in canes, reeds, bamboos; plants that have been used to weave baskets and mats, to make furniture or to build entire huts since millennia. Bamboos also make water pipes and seed drills, fishing rods and spears. Bamboo shoots are an excellent protein and vitamin rich source of food, and bamboo seeds are as good as rice. Bamboos have sustained livelihoods of thousands of specialist basket weavers, and provided employment for many more farm labourers in their spare time.

But to the Forest Departments of British India, bamboos were weeds that competed with teak, the prime timber species valued first for building ships and gun carriages, and later for furniture, doors and windows. The British wanted to reduce India's species rich forests to the sole production of monocultures of a few timber species—teak on the Western Ghats and in Central India, sal in Central and Eastern India, deodar and pine in the Himalayas, which meant getting rid of the myriads of other species, often of great value to local people, such as bamboo and Terminalias in the peninsula and oak and ash in the Himalayas. Thus bamboo was declared a weed to be eradicated and

Box 6

Patterns of resource use in the Indian society



Indian society may be divided into three components: ecosystem people who primarily depend on biomass procured from their surroundings; ecological refugees, many of whom live in city slums and have limited access to resources and omnivores, owners of larger tracts of irrigated land and city dwellers in the organized industry-service sector who have access to substantial amounts of resources drawn from all over the country.

if local people wanted to harvest it from land taken under the control of Forest Departments they had to pay. In 1860, for instance, the Government imposed a fee at the rate of 5 rupees per tonne of bamboo removed by basket weavers from the forests of Uttara Kannada. The local people vehemently protested against this imposition, but without success.

Bamboos owe their marvellous structural properties to their long fibres, and early in the twentieth century they were found to be an excellent raw material for paper production. It was declared that India's vast bamboo brakes could support unlimited paper production, and bamboo-based paper mills began to be established soon after the First World War. But the real thrust on development of forest-based industries came after independence and the district of Uttara Kannada had its first paper mill, the West Coast Paper Mill, established in 1958, a century after the British imposition of a fee on bamboo extraction.

With this shift in bamboo use, it was no longer considered a weed. Instead, it was made available to the paper industry at Rs. 1.50 per tonne; at exactly 1/1000 the market price, which then stood at Rs. 1500 per tonne. The Government, and its agency of Forest Department thus first took control of the bamboo resources from the ecosystem people, declared bamboo as a nuisance—even though it sustained the livelihoods of thousands—and then handed over the resource, essentially free of charge, to the omnivores. The whole operation was not based on any scientific information on the status and dynamics of bamboo stocks.

4
The Iron Triangle

4.1 Perverse incentives

This process illustrates well the operation of what political scientists term an iron triangle. The three major groups of actors involved in state sponsored flows of resources constitute the three apices of the triangle. These are (a) the beneficiaries of the state sponsored subsidies—such as forest based industries or farmers receiving electricity for their pump sets or canal irrigation water for their fields at costs well below what the state should charge (b) those who manage the resource flows—such as the forest or irrigation department bureaucracy; (c) those who decide on the levels of state support—the politicians. These three groups make up the omnivores of India (Box 7: Iron Triangle).

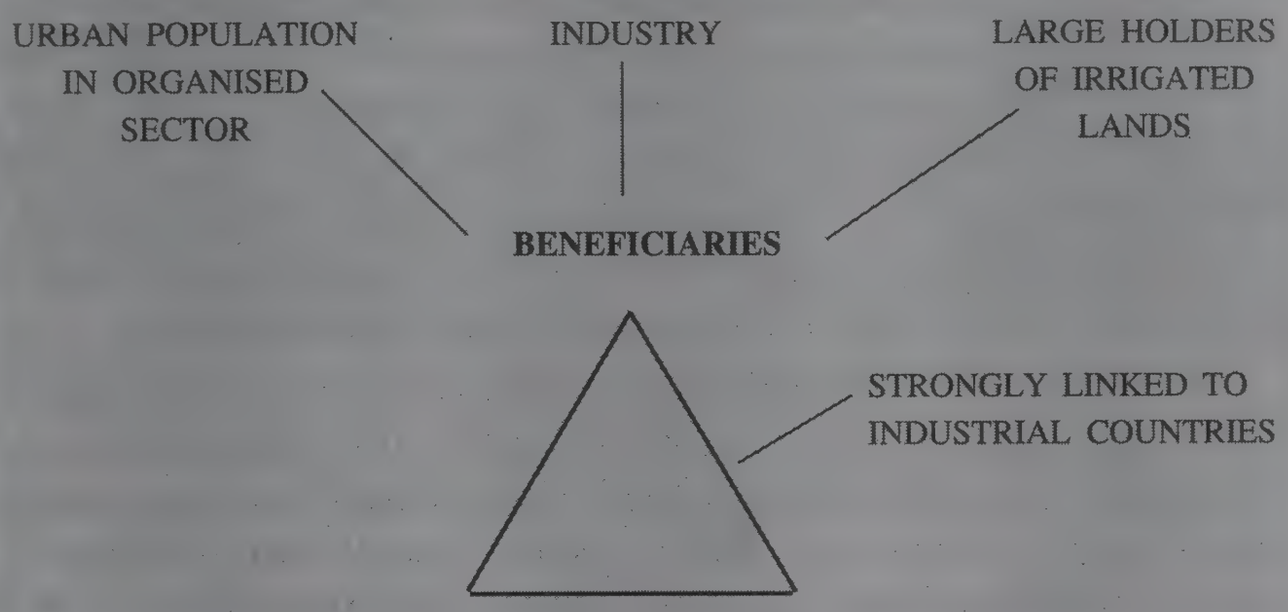
This system of state sponsored resource flows is at the root of the gross inefficiency of management of natural resources of the country. In this system those who put resources to use—such as the paper industry—have no motivation to use them efficiently or sustainably. Given the throw away prices at which alternative sources of raw material are made available, and given the seller's market created by the quota-permit-licensing system, the industry, even if it functions very inefficiently, is guaranteed high profits. The politicians and the bureaucrats currently operate in an opaque system in which there is no accountability. In consequence, they too have no stake in efficient and sustainable resource management.

4.2 Bamboo: A case study

The system of India's natural resource management is thus a system by the omnivores, for the omnivores and unfortunately at the cost of the country's heritage of natural resources, and of the vast number of people living at the subsistence level. The depletion of the country's bamboo resources over the decades since independence illustrates this. When the West Coast Paper Mill started functioning in the Uttara Kannada district in 1958, and was handed large forest areas for extraction of bamboo at throw-away charges, it was asserted that the bamboo resources of the state would suffice for itsrequirements

Box 7

The Iron Triangle Governing Resource Use Patterns in India



Large state-sponsored subsidies have created an iron triangle of components of Indian society benefiting from, administering and deciding upon state patronage. Constituents of this iron triangle are forcing the country into a pattern of exhaustive resource use at the expense of the environment and a majority of the people.

of 50,000 tonnes a year in perpetuity. To begin with the mass flowering of one of the main species, *Bambusa arundinacea* was not anticipated. Many species of bamboo have a remarkable life cycle involving vegetative growth without any flowering for a large number of years, followed by a massive bout of gregarious flowering involving the entire population of a species over a large region. Such flowering is followed by the death of all adult bamboo. This striking phenomenon is well known, indeed in years of such flowering bamboo rice is available in large quantities and used as food. Many illiterate villagers date historical events in relation to the last seeding of bamboo and these events are recorded in newspapers, books and gazetteers.

Bambusa arundinacea which grows vegetatively for about 45 years was due for massive gregarious flowering in Uttara Kannada district around 1960. Although this information was available in the literature, the forest managers and planners for the paper mill were apparently unaware of it and were taken aback by the sudden death of most individuals of this species (Fig. 4.1: Years of bamboo flowering). The paper mill of course, could draw upon other bamboo species such as *Dendrocalamus strictus.* Thus the paper mill had largely exhausted the bamboo resources of the district—expected to sustain it in perpetuity—by early 1970's. It was at that time that one of us (MG) was involved in assessing why this had happened. The chief reasons were:

Firstly, the Forest Department prescriptions on the harvesting regime, expected to lead to sustainable yields at the maximal level, were faulty. They

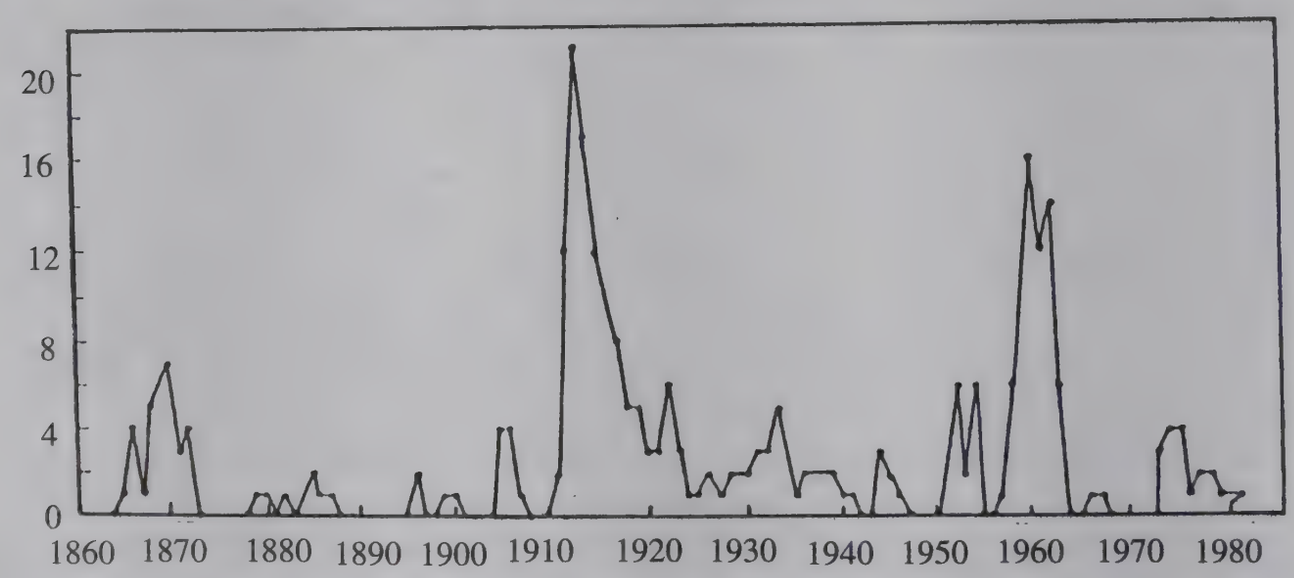


Fig. 4.1: Yearly mass seeding of *B. arundinacea*

were based on the assumption that individual bamboo plants had an S-shaped growth curve like other tree species. But the growth form of bamboo is very different; they have an underground stem from which come out branches that constitute the bamboo culms. A bamboo plant therefore grows at an ever-accelerating rate, and its culms should be extracted on a different pattern.

Secondly and more significantly the official prescriptions on harvesting bamboo culms left out an important issue—the role of the covering of thorny branches that develop at the base of each clump. The local people were aware that this thorny covering is of significance in protecting new bamboo shoots, and cut bamboos at a height. The prescriptions followed by the Forest Department of the West Coast Paper Mill, then headed by a retired Chief Conservator of Forests of Karnataka State advocated clearing up of this thorny covering and harvesting of entire bamboos from their base level. This fully exposed new bamboo shoots to grazing by wild pigs, monkeys, porcupines as well as cattle and buffaloes, and was detrimental to the continued recruitment of new bamboo culms. So the official prescriptions actually cut down on bamboo growth while the traditional local practices were compatible with continued growth.

Gross overestimates of bamboo stocks, and faulty prescriptions for the harvesting regimes, coupled with increasing pressures of livestock grazing in the Uttara Kannada district thus ensured that the West Coast Paper Mill ran out of bamboo stocks of the district projected to feed it in perpetuity, within fifteen years (Box 8: Sequential exploitation). But the unconcerned mill owners began bringing in bamboo first from Andhra Pradesh, then from Garhwal and Assam. They developed the technology of making paper from eucalyptus and brought it in from Goa. They leased private land in the neighbouring district of Belgaum and raised captive bamboo and eucalyptus plantations. The additional costs involved were passed on to the buyers in a seller's market. In any event, as a senior executive of the paper mill put it, they were in the business of making money, not paper. They had more than recouped their investments in the first decade when bamboo was available in abundance at their own doorstep, essentially free of charge. And if the paper mill had to be closed down, they had many profitable options for investing in—manganese mining, shrimp fishing, for instance. But the local people, the basket weavers had few such options and suffered a loss in quality of life from the exhaustion of bamboo stocks of Uttara Kannada.

Box 8

Sequential exhaustion of forest resources

The root cause of the decimation of India's forest cover lies in the way the constituents of the iron triangle operate. Receiving resources at throw away prices they have little interest in their sustainable use. Theory tells us that renewable resources fetching high profits compared to costs of harvest and processing would tend to be overexploited. It recommends adequate levels of taxation to curb this tendency. Exactly the opposite has been done in India, with resources already susceptible to overexploitation pushed further in that direction through state sponsored subsidies.

The result has been a concentration on resource elements that would yield the highest profit at any moment, resulting in their exhaustion through

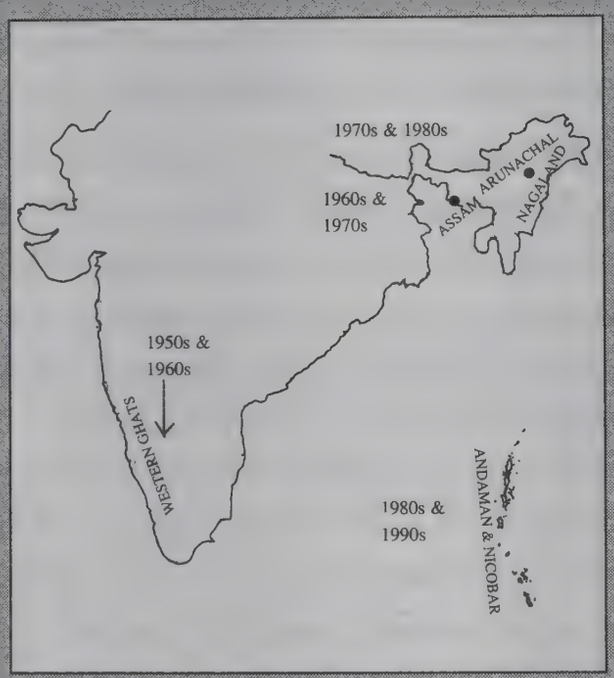


Fig. 1: Geographic shifts of the focus of exploitation of the plywood industry in India. The non-sustainable resource methods of this industry have kept it shifting over time to more and more remote areas of the country as resources from more accessible areas near exhaustion.

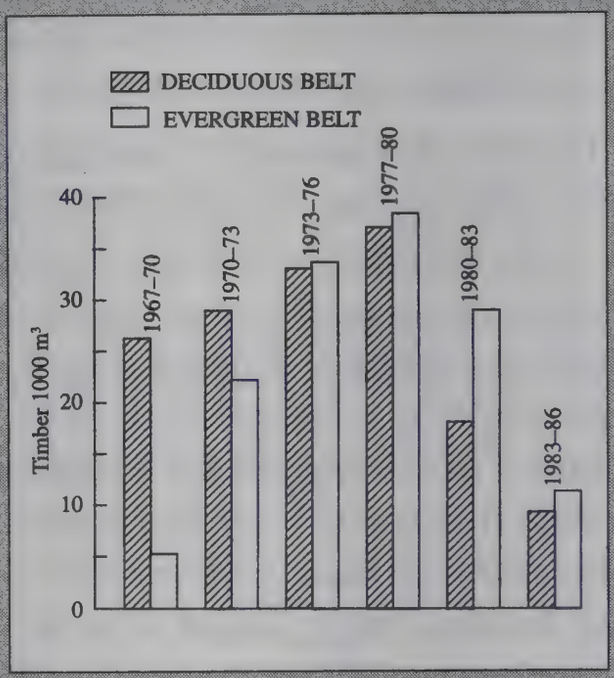


Fig. 2: Timber harvests by the plywood industry from the Uttara Kannada district of Karnataka State, 1967-86. It is evident that pressures of non-sustainable use have forced this industry to shift from more accessible deciduous forest tracts to less accessible evergreen forest tracts, and that timber supplies from both zones have fallen off.

excessive harvests, followed by switchover to the most profitable of the remaining resource elements. This is a process of **sequential exhaustion** that operates at many levels.

Thus, the Indian plywood industry has successively shifted its pressure of exhaustive use from Western Ghats to Assam to Nagaland to Andaman and Nicobar islands (Fig. 1). Within a given region, such as the Uttara Kannada district of Karnataka it has shifted its focus of exhaustive use from more accessible deciduous forests to less accessible evergreen forests (Fig. 2). Within the Ranni forest division in Kerala the working plans have successively converted hill slope areas under protection circle to be left intact permanently for watershed conservation into selection felling circle from which a proportion of trees is to be harvested on a sustainable basis, and then as this extraction proved to be non-sustainable, into conversion circle for clearcutting and raising of monoculture plantations (Fig. 3).

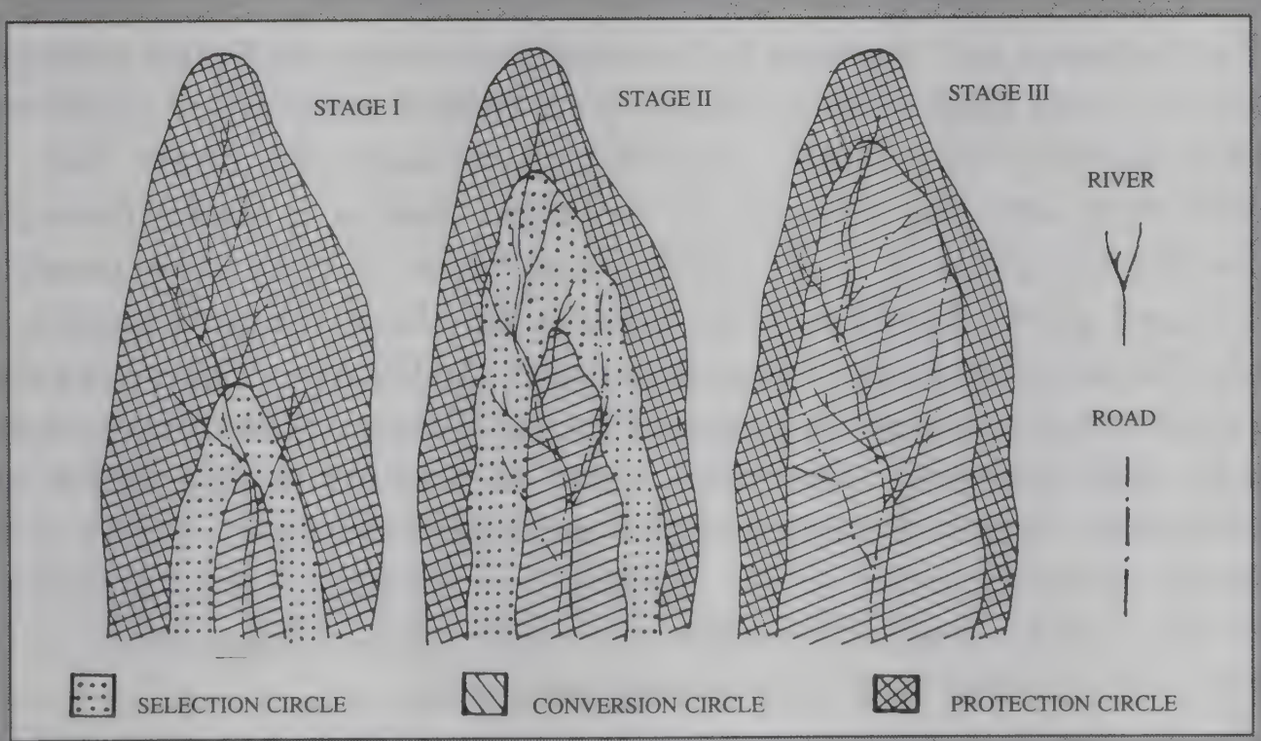


Fig. 3: Working plans of the Ranni forest division of Kerala, 1950-80. This figure shows that the protection zone (set aside for watershed conservation), selection zone (earmarked for extraction of a limited number of trees on a sustainable basis) and conversion zone (devoted to clearcutting and raising of monocultures of commercial species) have kept on shifting in response to exhaustive resource use.

4.3 Condemning traditions

The British conquered Uttara Kannada in 1799, with the defeat of Tipu Sultan, the Tiger of Mysore. The British East India Company then commissioned Francis Buchanan, a surgeon in its employ, to survey the terrain and report on its biological and mineral wealth in order to work out a strategy for effectively exploiting these resources for the company's profit, this being the sole objective of the East India Company. But the attitude of Buchanan himself, an accomplished naturalist and a pioneer of modern botanical research in India, is revealing. Camping near Karwar in 1802 he encountered a sacred grove, and we quote from him : "The forests are property of the gods of the villages in which they are situated, and the trees ought not to be cut without having obtained leave from the ... headman of the village, whose office is hereditary, and who here also is priest to ... the village god. The idol receives nothing for granting this permission; but the neglect of this ceremony of asking his leave brings his vengeance on the guilty person. This seems, therefore, merely a contrivance to prevent the government from claiming the property".

To Buchanan and the heirs to his attitude amongst the Forest managers before and after independence, India's great cultural traditions of conserving natural diversity were merely superstitious nuisance. No matter that the northernmost surviving stand of *Dipterocarpus indicus,* a species belonging to the flagship genus of Asia's tropical rain forests, is even today protected in a sacred grove, Karikanamman kadu, in the Uttara Kannada district; no matter that the green oases of Rajasthan desert, the Bishnoi villages, owe their tree cover to the taboo against cutting of khejadi, *Prosopis cinerarea*; no matter that the only large wild mammals to roam all over our thickly settled land are hanuman langurs, rhesus macaques and bonnet macaques, thanks to the religious protection given to the monkeys; no matter too that magnificent peafowl are to be found in hundreds over many parts of India, thanks to the culture of respecting them and leaving them alone.

In the early years of their rule, the British had no concern at all for conserving India's biological diversity. In fact, in 1870, a Major in the British Army proposed that the Government should raise a regiment for the exclusive purpose of ridding the country of the menace of tigers, leopards, wolves, snakes and other such vermin. This suggestion was rejected on grounds of economy, but

there are records showing that the Government of British India has paid cash rewards for the killing of huge numbers of tigers, leopards, and wolves, over a 50 year period from 1870 to 1920. As this carnage proceeded, populations of large mammals and birds were decimated across India. By early 1900's, the lion, once distributed extensively over large parts of north India was restricted to the Gir hunting preserve of the Nawab of Junagadh in Saurashtra. A lion with a mane was a trophy much valued by the British elite, and the Nawab had to pretend that the species had actually gone extinct to resist the pressure of visiting British bigwigs to bag one more head. The Nawab succeeded, and the lion continues to survive in the Gir National Park to this date.

5
Conservation Initiatives

5.1 Parks and Sanctuaries

As this destruction of nature proceeded, tentative steps were initiated to protect, not the overall diversity of life, but some of the larger, more appealing wild birds and mammals. The first wildlife sanctuary was the Vedanthangal Bird Sanctuary near Madras, set up in 1878, which merely formalized the traditional protection afforded by villagers for pelicans, herons and other birds breeding at Vedanthangal. Another such sanctuary was set up at Ranganathittu near Mysore, in 1942 under the British rule. Indeed such protection is part of India's ancient tradition; the epic of Ramayana opens with the sage admonishing a hunter for killing one of a pair of copulating "krouncha"—perhaps cranes or storks. In fact many of the present day wildlife sanctuaries or national parks owe their origin to Indian traditions of protection—partial or total—to nature. A notable component of this tradition was the hunting preserves of the nobility, recorded as early as Kautilya's Arthsasthra, two thousand years ago and continuing through the ages to the Gir hunting preserve of Nawabs of Junagadh.

Another well known national park, at Keoladev Ghana in Rajasthan, was once the waterfowl hunting preserve of the Bharatpur maharajas. It is a man-made wetland created in the mid-nineteenth century by damming a river, to serve for irrigation in the dry season. Keoladev Ghana is surrounded by villages and the lush grass growth in and around the marshes has traditionally supported grazing by large herds of cattle and buffaloes. Thousands of herons, egrets, storks, ibises breed here in the monsoon; it is also home to tens of thousands of ducks, teals, geese that visit India in the winter. For decades the wetlands of Bharatpur had been harbouring the water fowl besides supporting grazing by village livestock and large winter shoots by the Maharaja and his guests. In the 1950's, the wetland became independent India's first addition to the then fledgling system of protected areas, at the instance of Salim Ali, the greatest of the Indian naturalists of the 20th century. He was a personal friend

of the then Prime Minister, Jawaharlal Nehru, and the two together laid the foundation for the nature conservation effort in modern India.

5.2 An elitist approach

It was a pathbreaking and important initiative, yet flawed because of its elitist perspective, and its obsession with exclusion. From this perspective, nature conservation is seen as an endeavour to organize the official machinery to keep human presence out of the protected areas. These, in particular include not only sports hunting by the omnivores but also subsistence hunting by the ecosystem people, as well as a whole range of subsistence demands including grazing, fuelwood and other minor forest produce collection by the latter. The elite were urged to exchange their guns for cameras; indeed scions of aristocratic families, such as B.N.S. Deo, and M.Y. Ghorpade for whom hunting had been a great tradition emerged as outstanding wildlife photographers. So the cost of nature conservation was entirely passed on to the local communities, while the omnivores were little affected.

At Keoladev Ghana, for instance, waterfowl had been thriving for decades in the company of grazing buffaloes. Indeed, as it now turns out, they prospered largely thanks to the grazing buffaloes. But exclusion of grazing and other demands of local people was considered essential for the conservation effort by forest managers as well as scientists. Salim Ali wrote to Indira Gandhi asking for a ban on grazing, as did American wildlife biologists working for the Crane Foundation. Finally, the Government banned all grazing by village livestock by a simple order in November 1983, without providing any alternatives. The villagers protested and were fired upon, reportedly with several casualties. The main beneficiary of the guns and guards keeping the buffaloes away, was a water loving grass, *Paspalum*. Unchecked by grazing, it grew to choke the shallow wetlands destroying them as a habitat for the wintering ducks, teals and geese that the measure was supposed to help.

This experience has several important implications. Firstly, nature conservation need not necessarily be incompatible with human use. Indeed there is now a great deal of convincing evidence that subsistence use by ecosystem people of the Americas—the Amerindians, permitted and even promoted, high levels of natural diversity all over the north and south American

continents. What the romantic European conservationists treasured as primeval landscapes—places like Yesomite—were in fact highly humanized landscapes moulded by thousands of years of use by indigenous people. This is also true of Amazonia, and it has been the case over much of the Indian subcontinent, covered in many places by "an ocean of trees" and teeming with wildlife when the British first arrived.

5.3 Disturbance and diversity

Indeed, ecologists now believe that highest levels of diversity in terms of numbers of species present in a locality occur in a community with moderate levels of human intervention rather than in a biological community totally free of human disturbance. This is because disturbance can create more heterogeneous environmental regimes permitting not only species favouring less disturbed conditions to persist, but also making room for other species thriving under more disturbed conditions. This is why the number of species of birds encountered on two hour belt transects in forests of Uttara Kannada district of Karnataka are negatively correlated with canopy cover, being fewer in the less disturbed evergreen forests, but are positively correlated with the coefficient of variation in the canopy cover, increasing in moderately disturbed semi evergreen forests with more patchy canopy (Box 9: Disturbance and species diversity on Western Ghats).

This does not mean that disturbance is wholly favourable to diversity. A few of the smaller number of bird species of undisturbed evergreen forests of Uttara Kannada, such as the whitebellied blue flycatcher, *Muscicapa pallipes* are restricted to that type of forest and would disappear without it. On the contrary, a good proportion of the larger number of bird species of the more disturbed forest environment is very widely distributed and in no danger even if such forest was to disappear from the entire Western Ghats. Nevertheless, it is important to note that overall biological diversity can, in fact, increase under moderate levels of disturbance provided some habitats are maintained totally free of any disturbance.

5.4 Sacred sites

The traditional patterns of land and water use in India did indeed create such a mosaic of patches of different levels of disturbance as might have been

Box 9

Disturbance and Diversity

Drastic human disturbances often depress levels of diversity of life, as when rain forests are replaced by uniform stands of eucalyptus trees. But modest levels of disturbance often promote diversity by creating more heterogeneous environments. This is well brought out by the work of the Western Ghats Biodiversity Network. Members of this group have surveyed tree, bird and butterfly faunas of a variety of habitats at 20 different localities on the Western Ghats. Three of these, evergreen, semi evergreen and scrub savanna represent increasing levels of human interventions. Diversity levels of living organisms may be measured in many different ways. Two of these are the species richness, or the number of species in a given sample locality corrected for the number of individuals encountered and dissimilarity of pairs of communities in terms of their species composition.

	Evergreen		**Semi evergreen**		**Scrub savanna**	
	Richness	**Dissimilarity**	**Richness**	**Dissimilarity**	**Richness**	**Dissimilarity**
Trees	26.6	0.864	29.7	0.898	20.5	0.76
Birds	7.13	0.745	7.4	0.794	7.02	0.903
Butterflies	2.86	0.899	2.8	0.885	2.63	0.956

The table above gives mean values of between 9 to 49 samples for each habitat type for each group of organisms. Note that species richness, the number of different species in a given sample is greater in the semi evergreen, rather than in the least disturbed evergreen forest for trees and birds, but not for butterflies. Dissimilarity, or the rate at which new species come in as we move from one patch of a given kind of habitat to another is also greater for the more disturbed habitats, semi evergreen in the case of trees, and the most disturbed of the habitats, scrub savanna in the case of birds and butterflies.

entirely compatible with the maintenance of high levels of biological diversity. Such a mosaic included intensively managed areas such as fields and orchards, moderately disturbed areas such as village woodlots from which some wood, leaf loppings and fruit would be removed in a regulated fashion, and totally undisturbed areas protected as sacred groves or sacred ponds. This practice of setting aside refugia, or totally undisturbed sites such as sacred groves or ponds seems to have arisen in many different cultures the world over, perhaps in conjunction with the beginning of agriculture.

Sacred groves have been widely recorded from Asia and Africa, while a sacred grove of cacao has even been recorded in Mexico. Sacred groves were prevalent in pre-Christian Europe as well; indeed many churches were built on sites earlier occupied by sacred groves as Christianity spread to Europe. A widespread network of sacred groves apparently covered India in pre-British times; Dietrich Brandis, the first Inspector-General of Forests for India lamented the disappearance of most of these under British forest management. Sacred groves have nevertheless continued to survive in India to this day in the more remote regions populated by relatively autonomous, small scale tribal and peasant societies.

It is possible to arrive at some estimates of the proportion of landscape and waterscape thus set aside as totally undisturbed biological communities in pre-British times. The traditional prescription for those bringing new land under cultivation in Kerala was to set aside 1/7th, i.e., 14.3 per cent of the land as groves dedicated to cobras. A little to the north, we have used the local names of landscape elements to reconstruct the traditional land use pattern in a 5 km x 5 km area in Siddapur taluk of Karnataka's Western Ghats. This exercise suggests that 9.3 per cent of the land was originally maintained under sacred groves, which constituted 10 patches ranging in size from 1 ha to 134 ha (Fig. 5.1: Reconstructed landscape of Siddapur). The system of sacred groves endured closely in its original form till as late as the 1950's in parts of northeastern India. It is therefore possible to assess it on the basis of accounts of people who had personally known all areas that used to be treated as sacred sites. We have attempted to do so for several villages of the Gangte tribe in Churchandpur district of Manipur. Their accounts suggest that somewhere between 10 per cent to 30 per cent of the area used to be left inviolate, under

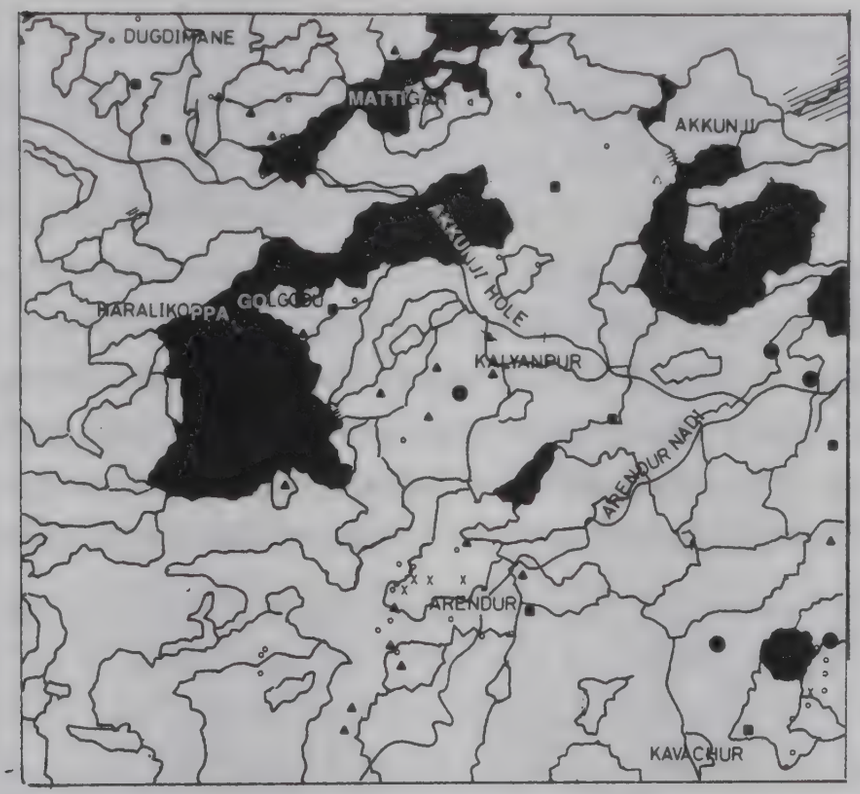


Fig. 5.1: Presumed patterns of land-use prior to British occupation in the early 19th century in a 5 km x 5 km area of Siddapur taluk in Karnataka Western Ghats (14° 16'N lat. and 74° 54' B long.) The land-use was reconstructed on the basis of local names of individual landscape elements. The black areas were sacred groves, remnants of which persist to this day.

natural biological communities during their shifting cultivation cycles. These practices were abandoned in large measure over the last half century as commercial demands and new religious beliefs made their inroads. But notably, adequate protection to some of the sacred groves has been revived in parts of Manipur and Mizoram, as people have realized the positive value of these refugia, especially as fire breaks between habitation and patches of slash and burn cultivation.

Such a system of land use would have created a mosaic of undisturbed patches of terrestrial and aquatic habitats of sizes ranging from a hectare or less to hundred or more, separated from each other by no more than a few hundred meters of other, more disturbed habitats. It is possible, of course, that certain organisms requiring much larger contiguous patches of pristine habitats may have disappeared under these conditions. But most likely a vast majority of organisms requiring totally pristine habitat conditions would still have survived, perhaps even thrived in such a mosaic.

5.5 Keystone species

Such a system of refugia was complemented by the promotion of keystone resource species such as *Ficus glomerata. F. glomerata* is widely venerated over India as a sacred species. It occurs both in the wild, occupying a spectrum of habitats ranging over the high altitude sholas to evergreen and deciduous forests, and also around habitation, as cutting it down is taboo. *F. glomerata* ensures a continuous supply of fleshy fruit for birds, bats, civets and monkeys round the year. Many other plants and animals were also protected through religious taboos in several parts of India, creating an environment greatly promotive of biological diversity over most of the subcontinent.

This is not all irrelevant history. Tattered as it is with the last two centuries of systematic abuse, relics of our rich cultural tradition of maintaining a biodiversity friendly milieu are still evident around us, in the survival of millions of banyan, peepal, neem and khejadi trees and thousands of peafowl, langurs and macaques in our villages, towns and cities. In the continued existence of heronries like Kokre Bellur in the midst of villages and in the sacred pools along many of the peninsular rivers. They survive in hunting preserves of India's aristocracy such as the Gir National Park and Bandipur Tiger Reserve. It is this culturally diverse tradition that we must build upon to shape a truly Indian effort at conserving, restoring and utilizing our rich heritage of biological diversity.

It is not only worth our while to respect and build upon the old, it is important to realize the limitations of the new approaches. A significant lesson drawn from the Keoladev Ghana tragedy is that we do not understand much about the behaviour of complex natural systems. Dr. Salim Ali and his colleagues had been watching birds, ringing them, trying to appreciate what made the place a conducive bird habitat for some decades before grazing was banned. Yet they could not anticipate that this step would destroy the habitat for the very waterfowl they wished to see better protected. This does not in any way reflect on Salim Ali. It is a fact of nature that it is simply impossible to predict the future of such complex systems, especially the impacts of major interventions in such systems with any accuracy. Another instance is the scallop fishery incident off the east coast of Canada. Fishery scientists were convinced that there was overfishing and were advocating a reduction in the level of fishing

effort, just as a viral epidemic struck the sea urchins of the area. Sea urchins are major natural predators on the scallops, and as the sea urchin population declined, the scallop population increased, despite heavy human harvests, embarrassing the fishery scientists no end.

Given these facts of nature, it is only appropriate that scientists and managers accept a measure of humility. It is evident that we can never be certain of how a particular intervention would affect the system. It is then best not to attempt sudden, large interventions—as the total ban on livestock grazing at Keoladev Ghana was—but experiment more guardedly with smaller, more careful interventions. The consequences of such interventions should then be monitored to improve the understanding of the system behaviour, and used to suggest further careful interventions. This would be a flexible approach, continually acquiring and taking advantage of new information. That is in stark contrast to the current bureaucratic approach which has rigidly stuck to the ban on grazing in spite of clear evidence of its ill effects.

6
Our Weaknesses

The weaknesses of Indian society that lead to highly inefficient, wasteful use of natural and informational resources may be summarized as follows:

- A narrow based elite in the organized industries-services sector and larger landowners control the country's political-bureaucratic apparatus. This elite has organized large scale state-sponsored flows of natural resources for its own benefit being at the core of national economic development, at the same time shielding itself from the negative consequences of environmental degradation. Enjoying large public subsidies, none of the people who so control the natural resource base have any interest in the efficient, sustainable use of these resources. Given the lack of interest in the efficiency of resource use, there is little interest in good information pertaining to the resource base either.
- A corollary of this elitist control over the country's natural resources is the disempowerment of the masses who depend on resources gathered or produced from their immediate environment to meet most of their needs. It is these people who bear most of the cost of environmental degradation and who could be most readily motivated to take good care of the natural resources of their own localities. But having no control over these resources, they too are today contributing to its further degradation in their own scramble to eke out livelihoods.
- The bureaucracy retains a culture of undue secrecy as a hangover from its colonial past. It maintains a monopoly over most information, almost all of it being of very poor quality. Thus there is woefully inadequate information on harvests of medicinal plants, or cultivars of mango in the wild or on farmers' fields, and such information as exists is not readily accessible either to entrepreneurs engaged in the pharmaceutical or seed industry, or to citizens concerned with the conservation of these plant resources.
- The rural masses dependent for their livelihood on natural resources have a wealth of detailed knowledge of the status and dynamics of these resources

in their own localities. Thus the tribals collecting medicinal plants from forests on behalf of traders know a great deal about these plants and how their populations are faring, as local fisherfolk do about fishes in their streams, and changes in water flow and water quality. But there is no recognition, no synthesis, no utilization of this valuable information by either the resource managers or by the scientific community.

- Programmes of conservation of natural diversity are reduced to bureaucratic efforts at keeping local communities out of protected areas such as national parks. This alienates local communities who are denied traditional access to grazing or to medicinal herbs and who have to bear other costs such as depredation of their crops by elephants. At the same time, there is no recognition of India's rich traditions of conservation, such as protection of khejadi trees, deer, antelopes and birds by the Bishnoi communities of Rajasthan, protection of fish in temple tanks or nurturing of keystone species such as peepal and banyan all over India.
- Another hangover of the colonial legacy is the preoccupation of our scientific community with trends in vogue in Britain and United States. Since none of this has relevance to India, our scientific community has been neither serving the Indian industry, nor social concerns such as sustainable use of natural resources. There being no history of "slow" science—such as our traditions of Ayurveda, or the practical ecological knowledge of our tribals or fisherfolk—in the West, there exists no tradition of synthesis of "fast" and "slow" science. In consequence, the Indian scientific community too has never addressed this significant challenge. The small minority who have attempted to do so, have merely glorified our past, failing to critically assess "slow" science and bring it into the mainstream.
- Our educational system too suffers from a colonial hangover. We continue to train our science students as if we were still producing clerks to undertake routine tasks for the British Raj. There is therefore an overemphasis on bookish learning and exams rather than nurturing of critical attitudes, of first hand observations of natural phenomena, and encouraging of innovative ideas. Our teachers and students of biology, for instance, have hardly any contact with the natural and domesticated wealth of life in their own local environs and make no contribution towards generating useful information on these issues.

- Fattened on state subsidies and operating in a protected sellers' market, our industry has continually depended on imported technologies, neglecting R & D activities which would help to develop innovative products. Thus, the pharmaceutical industry has made no effort to exploit our traditional knowledge base of use of medicinal plants, nor has the seed industry put to use our rich resources of genetic variability in crops such as rice or citrus.

  This lack of indigenous innovative effort is coupled with a reluctance to confront the whole issue of intellectual property rights regimes. But having been forced to accede to GATT, a consequence of the weak position we find ourselves in because of our own inefficient use of our natural and intellectual resources, we are being forced to implement several measures of intellectual property rights protection. We are poorly equipped to handle this transition.

- Finally, our fascination for the Western civilization has blinded us to the fact that the Southeast and East Asian countries are fast overtaking the West in many ways. We share much of our biological wealth with our Asian neighbours, and have much to gain from joint programmes of conservation and utilization of our living resources. We also have strong cultural affinities with many of these Asian neighbours and could profit in very many ways from working with them. We have permitted these opportunities to go a begging so far.

7
Environment and the National Agenda

7.1 Emerging objectives

Where, then, do we go from here? There is today an emerging consensus on the broad national agenda. This includes our pursuing four sets of objectives: economic, social, international and environmental. The economic objectives include vigorous economic growth and competitiveness in the emerging global economy. The social objectives include alleviation of poverty, generation of rural employment, empowering the disempowered through decentralized panchayati raj institutions, justice for the disadvantaged—women, scheduled castes and tribes, backward castes. On the international front, objectives include defence of national integrity and sovereignty, non-alignment and integration with the now vibrant community of Asian nations. The environmental objectives include halting forest loss, restoration of degraded lands, control of pollution and conservation of biological diversity.

There would be little dissension, at least on the surface, with this broad set of objectives. But those of us seriously committed to the environmental agenda, must face the reality that this agenda comes way down the list of priorities for most of our countrymen and women, well after the economic, social, international goals. Other, more controversial objectives such as total prohibition arouse greater passions. The pursuit of the environmental agenda against other more broadly accepted goals is a task that is generally doomed to failure. But this is what many proponents of nature conservation do. Typically, the die-hard conservationists question both economic and social objectives; believing in the fundamental incompatibility of conservation and all human use whether at subsistence or commercial levels; condemning pursuit of economic growth and at the same time calling for tribals to be thrown out of national parks. Others are more temperate and call for a better deal for tribals, but do not spell out how this is to be accomplished. Yet others endorse the social objectives, but believe that the pursuit of economic growth along with integration into global economy cannot be reconciled with conservation.

7.2 Efficiency and equity

While we respect the good intentions and sincerity of these environmentalists, we question the feasibility of their prescriptions ever getting the public support required to translate them into practice. However, the situation is not hopeless. The economic and social goals can indeed be pursued simultaneously with the environmental objectives by focusing on enhancing the efficiency of use of natural and informational resources. This is feasible because the cause of economic growth and competitiveness would be greatly helped by an enhancement in the efficiency of resource use. At the same time, such efficiency will be promoted by pursuing social objectives of decentralization, universal literacy and empowerment of women. Environmental objectives must therefore be pursued simultaneously with efficiency of resource use. It would be our endeavour to try and sketch how we may do so. Our particular focus in the discussion will of course be on the conservation and sustainable use of biological diversity.

This approach to conservation is based on the recognition of two principles: (1) There are valuable elements of biological diversity in all parts of the country's landscape, waterscape and seascape; within and outside protected areas, in pristine as well as highly human impacted ecosystems; (2) Conservation of biological diversity does not call for total exclusion of all human use.

7.3 A broad spectrum approach

The focus of the effort at conservation of biological diversity must today be on the entire spectrum of living organisms, including the vast magnitude of seemingly inconsequential, minute insects, mites and fungi. This is because modern scientific developments now enable us to take advantage of biological products, and the genetic material underlying their production from any living creature. Thus spiders and scorpions with their venoms acting on nervous systems are now being screened in the belief that these may hold a clue to the cure of neural disorders. Similarly the American pharmaceutical giant Merck has signed a contract with the Costa Ricans to screen extracts from thousands of insect species of that country's tropical forests for possible therapeutic properties.

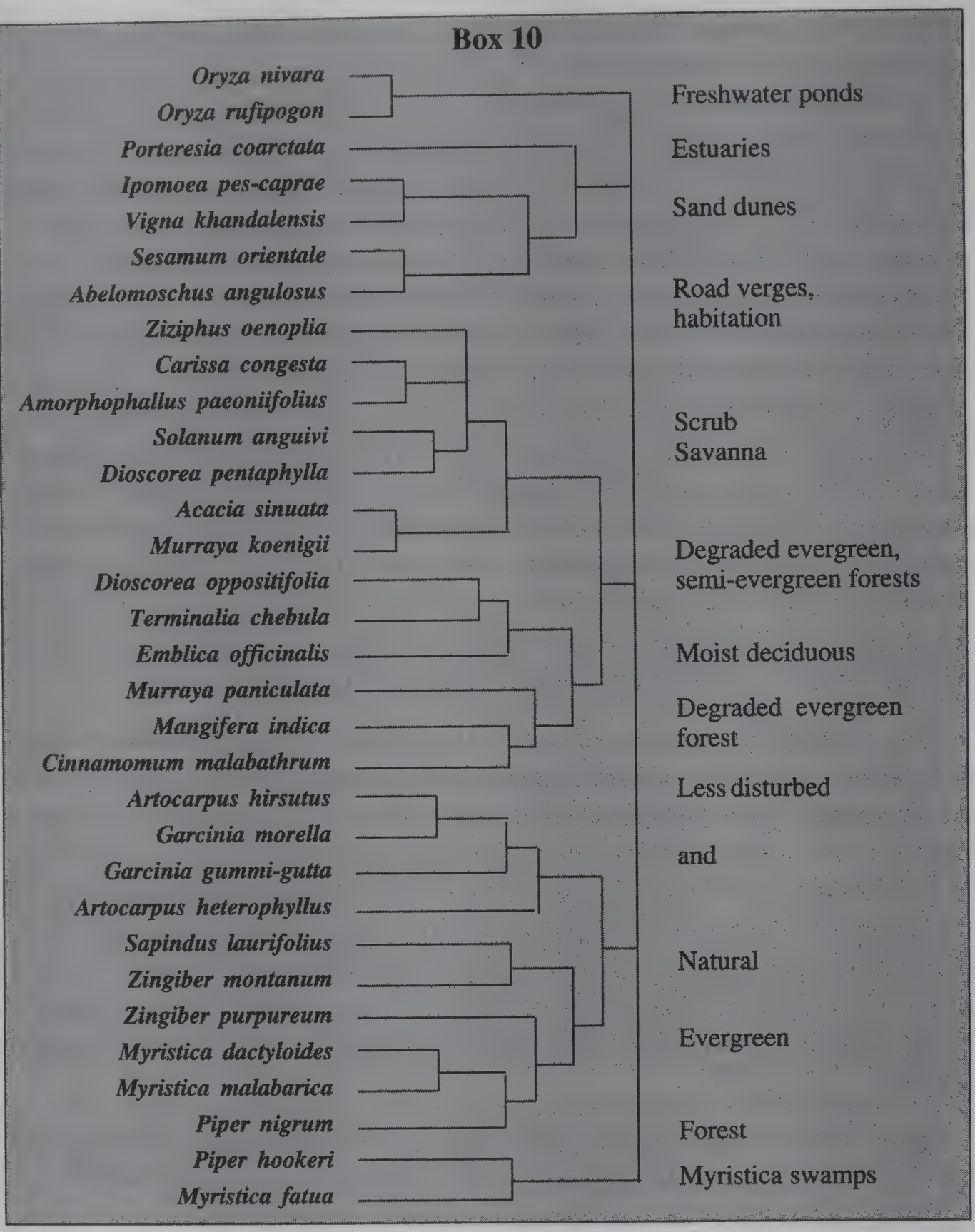
One such resource of great economic promise is the wild relatives of cultivated plants. People depend on plants in many, many different ways; as sources of food for themselves or their livestock, of fibre for weaving clothes, mats or baskets, of organic manure for replenishing the fertility of cultivated lands, of medicinals for maintaining bodily health, of flowers for decorating themselves and of pigments for dyeing clothes. So they have been gathering material from an incredible variety of plants; herbs, shrubs, climbers, trees, epiphytes; growing in water, salt and fresh, stagnant or flowing; and on land, from rain forests to deserts, from lowlands to mountain tops. A fraction of these have been tended and deliberately encouraged to survive, grow and propagate. These cultivated species too belong to a whole range of growth forms, and the entire spectrum of land and freshwater habitats. Cultivated plants by no means come only from the more natural, primeval habitats. Rather, people have been apt to select for husbanding plants that occur in their proximity, in relatively more human impacted habitats. Cultivated plants therefore, often come from habitats such as scrub and grasslands, many of which owe their existence to repeated fires set by people (Box 10: Dendrogram of wild relatives of cultivated plants of Uttara Kannada district).

The primary motivation for the conservation of wild relatives of these cultivated plants is the potential application of their genetic material in the enhancement of the performance of the cultivated plants. Such genes may pertain to a variety of characters ranging from size and density of root hair to seasonality in leaf shedding or fruiting, from amino acid composition of the proteins to the nature of chemicals released from roots into the soil. There is therefore a strong interest in maintaining the total range of genetic diversity of these wild relatives—an objective that calls for the conservation of multiple populations in the wild over the entire geographical range of the concerned species.

These requirements, the need to conserve multiple populations of several species preferring a wide range of natural and human impacted habitats are not restricted to the objective of conserving wild relatives of cultivated plants. Rather they characterize the current broader objectives of biodiversity conservation. This suggests that the traditional approach of conserving biological diversity in a few protected islands of natural habitats needs to be considerably

E-100
N98
1657

Box 10



A schematic dendrogram for 32 species of wild relatives of cultivated plants of Uttara Kannada district. The shorter the length of branches connecting any group of species, the greater the similarity in the types of habitats they occur in. The broad habitat types of the major species groups are indicated to the right of the dendrogram.

modified. Multiple populations of a number of species preferring a whole spectrum of habitat types can be effectively conserved only through prudent management of the entire landscape and waterscape of a whole region. Such extensive tracts cannot be set aside exclusively for conservation purposes. Conservation oriented management will have to be pursued in conjunction with use and development of the natural resources of the region to fulfil human aspirations.

8
Custodians of Diversity

8.1 Involving people

This broad spectrum approach can only be pursued with an equally wide participation in the endeavour by masses of people. We must then stand the current system of managing biodiversity on its head, and assign the role of custodians of biodiversity to local communities of people who live close to the earth; to the tribals, peasants, herders, fisherfolk and rural artisans. These people have for centuries obtained their livelihoods from their immediate surroundings without destroying the natural diversity; its rapid erosion has largely followed large scale commodification of nature in the last two centuries. Their traditions such as sacred groves have permitted survival of unique species like *Kunstleria keralensis* in the coastal plains of Kerala with population densities exceeding thousand per sq. km. They have an intimate knowledge of natural resources, although it is often restricted to very limited localities. They are amongst the poorest of Indian people and would be willing to serve as custodians of nature for relatively low levels of compensation.

The experience of recent years has shown that such communities of ecosystem people are often willing, even eager to take on this role when permitted to do so. The most notable instance of this is the experiment of joint forest management initiated some twenty years ago in the predominantly tribal Midnapore district of West Bengal. The natural vegetation of this tract is dominated by sal *(Shorea robusta)*, an excellent coppicer. Large tracts of sal forest of Midnapore had been reduced to poor scrub growth by mid-1970's, although the tree root stock remained intact. Some imaginative Forest officials therefore offered the local communities a share in the timber if they accepted the responsibility of protecting a forest patch and ensured good coppice growth. This step was successful because the local tribal communities were relatively homogeneous, and because the State Government of West Bengal had introduced a system of decentralized governance that helped local communities get organized to deal effectively with the bureaucracy. Thus protection led to rapid tangible

results in the form of coppice growth of sal. The success of this experience encouraged the State Government of West Bengal to formally recognize the role and rights of village level forest committees. This prompted the Government of India to issue in June 1990, an order urging other State governments to formulate rules encouraging the operation of village level programmes of joint forest management. The response to this initiative has been remarkable and the last few years have witnessed the spontaneous formation of several thousand village forest committees spanning the length and breadth of the country.

Villagers participating in such joint management programmes are motivated by more assured access to enhanced levels of plant biomass for fulfilling their manifold subsistence needs of food, fuel, fodder, drugs, leaf mulch, as well as higher levels of income through marketing of non-timber forest produce such as sal leaf plates and in the long run, mature timber. They utilize a considerable variety of species for subsistence, and sell a great diversity of non-timber forest produce. The village forest committees therefore promote much higher levels of diversity than the State Forest Departments who tend to focus on a few commercial species such as teak or eucalyptus. Additionally, the village forest committees have been working without any financial inputs on the part of the state; organizing themselves and managing the resource on a voluntary basis. Empowering local communities to control and benefit from the local natural resource base is thus a powerful and highly cost effective route to conservation of biological diversity.

8.2 Promoting larger interests

There is, however, a distinct limitation to the range of diversity that the villagers would be motivated to protect on grounds of utility. The larger interest in the protection of the entire spectrum of biodiversity would obviously encompass many additional elements which would be of no immediate value to the local communities. Thus dead trees left standing for years are an important habitat for a whole range of wood eating insects, wood rotting fungi and hole nesting birds that may play no role in village economy. Villagers however, would be immediately inclined to harvest such dead trees and use them as timber or fuelwood. If we wish to motivate them to conserve such habitats, we need to offer additional incentives. It is therefore clear, that if the rationale for

conservation of biological diversity includes retaining options for future economic use, or is based on ethical or aesthetic grounds, simply assuring access to villagers for immediate use would lead to socially sub-optimal levels of biodiversity conservation. The larger Indian (or global) society must then mobilize additional resources to raise the level of conservation efforts towards socially desirable levels. Today such additional resources are indeed being made available, but are used in a highly wasteful manner by the state bureaucracy. We must, instead, explore alternative avenues of using these resources to involve local communities in a far more effective programme of conservation and sustainable utilization of biological diversity.

A more effective approach must aim at greater efficiency by keeping the costs of conservation as low as possible. The costs of conservation may be reduced in five ways: (a) by accepting that conservation may be combined with certain economic pursuits and then promoting those pursuits that are most compatible with conservation objectives; (b) by assigning the role of custodians of biodiversity to those involved in some of the economic pursuits compatible with conservation, so that the custodians are willing to perform for relatively modest levels of compensation; (c) by assigning the role of custodians to those in intimate contact with the biological communities being managed, so that the custodians can perform their role effectively; (d) by assigning the role of custodians to the economically underprivileged, so that the custodians are willing to perform for relatively modest levels of compensation and last, but not the least, (e) by establishing a firm link between conservation performance and the compensation paid to the custodians.

8.3 Social justice

Such a system would also serve the interests of equity in two ways: (i) by passing on the costs to those who would benefit from the conservation effort, and those who are wealthier and therefore in a better position to bear such costs to promote long term, socially desirable objectives, and (ii) by passing on the benefits associated with conservation efforts to the economically weaker sections of the society by preferentially involving them in: (a) economic activities deemed compatible with maintenance of high levels of biodiversity; (b) as custodians of biodiversity who may receive some compensation for their role.

9
Governing the Commons

9.1 Outstanding questions

We then visualize additional resources mobilized by the state flowing to the local communities to encourage them to adopt resource use practices that would promote biodiversity. This is analogous to the subsidies farmers in some countries receive to adopt land use practices in the broader interests of soil conservation or payments made by Nature Conservancy in the U.S. to landowners to adopt land use practices compatible with the conservation of biodiversity. Our focus is on communities, rather than on individuals, for we are primarily concerned with public lands and waters.

To operationalise such a proposal would require answers to a whole series of questions:

(a) How are local communities to be bounded? How homogeneous must such communities be? How many households should they involve? (b) How to assign parcels of land and water to particular local communities to manage in the interests of biodiversity? (c) How can local communities be organized on a hierarchy of spatial scales, to enable them to manage local natural resources effectively in the interests of biodiversity? (d) How should the national or global society go about assigning conservation value to different elements of biodiversity? How should this information be shared with local communities? (e) How to arrive at the levels of financial or other incentives to be awarded to local communities to conserve biodiversity? (f) How to ensure that conservation performance of local communities is firmly linked to the level of rewards flowing to them? (g) How to generate the funds used to promote biodiversity?

9.2 Designing alternative institutions

Evidently we need to design and build a series of alternative institutions to manage the country's biodiversity, while dismantling the ineffective parts of the existing machinery. We suggest below a broad approach to such a task; it is

important that care be taken to ensure sufficient flexibility to permit the emergence of institutions appropriate to the local conditions.

The basic unit of human society is a group of people in day-to-day face-to-face contact, comprising about 20 to 200 households living in a hamlet, a small village or a ward of a larger village or town. Such a unit would be relatively homogeneous, economically and culturally, and likely to act in a cohesive fashion. Such a group should constitute the basic element of a community based resource management system. It should be authorized to manage all of the commons, i.e. the public lands and waters within a defined territory, and to co-ordinate actions of private land owners within the bounds of such a territory. This management would of course operate within a broader socially acceptable framework which may specify that no public lands or wetlands should be brought under cultivation, or that no trees belonging to the genus *Ficus* should be felled. The local communities should be organized into larger and larger groups within a nested hierarchy with the larger groups serving to co-ordinate the activities of component neighbouring groups and to resolve disputes. The larger resource management groups should form appropriate links with political institutions at corresponding levels: panchayat or village cluster level corresponding to a population of around ten thousand, taluk or county level corresponding to a population of around a hundred thousand, and district level corresponding to a population of around a million.

A number of difficulties would of course arise pertaining to the complexities of social organization and to the overlap of areas of resource use by neighbouring communities. Special cases of overlap would involve nomadic herder communities. For such difficulties, it would be best to create institutions which can provide locality specific solutions.

9.3 An integrated approach

This would be an integrated system of managing the country's natural resources, replacing the current bureaucratic regime that has greatly fragmented control over and management of the country's natural resources amongst revenue, forest, irrigation, public works and other departments. The bureaucratic regime has also established a monopoly over all information pertinent to environmental management treating the practical ecological knowledge of the people as

irrelevant and providing no role for the extensive network of schools, colleges, universities and research institutes of the country in this process. We visualize instead that in any locality, all public lands and waters will be managed on an area basis in an integrated fashion in conjunction with the privately controlled lands and waters with the threefold objectives of sustainable use of natural resources, conservation of biological diversity and maintenance of a healthy public health environment. We also visualize this process as involving local communities as the principal actors, and being based on careful use of locality specific information through extensive involvement of local schools, colleges and research institutions.

The Panchayat Raj institutions must play an important role in this process. But the coverage of the lowest level panchayats outside of scheduled tribal areas is still too extensive to do justice to the highly locality specific task of managing natural resources. The proper basic units for such a task will have to be the units assigned the task of management in the Extension of Panchayats to Scheduled Areas Act of 1996, passed by the Indian parliament on the basis of the recommendations of the Bhuria Committee. These will be individual hamlets, settlements or villages with a community of something like 200 households in regular face-to-face contact. We therefore visualize "Village Nature, Health and Education Committees (VNHEC)" as the foundation on which the environmental management of the entire country would be built up through a bottom-up process. These institutions should also play an important role in more effective management of public health, and revitalization of the educational system by relating them closely to first hand experience of local environment and development issues. These village level institutions will have to be properly linked to the Panchayat Raj institutions at village cluster, taluk and district levels.

9.4 Supply and safety regimes

In place of the current fragmented system, we propose two basic regimes of environmental management: a supply regime for fulfilling the natural resource demands of the local people, as well as of the larger economy, and a safety regime focusing on the provision of ecosystem services and conservation of biological diversity.

The larger safety sites shall primarily consist of existing protected areas and some additional areas with ecosystems preserved close to their natural state.

These shall include ecologically significant areas of forests, deserts, rivers, wetlands and oceans. The remaining public lands and waters shall form supply sites for fulfilling the natural resource demands of the people and the larger economy. A series of much smaller safety zones (on the model of sacred groves and sacred ponds) embedded in the supply sites would complement the larger safety sites. The management of safety sites will focus on the provision of ecosystem services and conservation of biodiversity with adequate provisions for fulfillment of the basic needs of the local people. A system of positive incentives should be created to promote maintenance of high levels of biodiversity in both supply and safety sites.

9.5 Rights and role of the local community

All publicly owned natural resources within the territorial limits of a unit of management such as village/hamlet/settlement, whether classified as supply or safety sites should be the collective property of the local community. The community should enjoy rights over all biomass, minerals, rocks and intellectual property rights pertaining to knowledge of uses associated with these lands and waters especially uses of living resources such as medicinal plants. The community should have an advisory and supportive role in the management of private property as well. Enjoyment of these rights should be linked to continued good management of these resources and adherence to certain norms by the community. Such norms should aim to protect the long term interests of the community, as well as of ecosystems, promote equitable sharing of benefits especially with the weaker sections and incorporate a system of performance based rewards.

The livelihood and culture of tribals is closely inter-linked with forests. The livelihood of traditional fisherfolk and nomadic graziers and shifting cultivators may depend on access to resources across territories of several village communities. The new collective property regime under VNHEC is likely to increase their cost of resource gathering and bring uncertainty in contractual arrangements made with individual VNHECs. The interests of such special groups should be adequately protected.

9.6 Primary health care

Since basic health care is intimately linked to the maintenance of a healthy public environment, including availability of medicinal plants, village community

level institutions involved in the management of natural resources should also be simultaneously responsible for a comprehensive system of primary health care under decentralized management. These institutions should look after all the promotive and preventive health care services, as well as organize certain curative aspects requiring simple skills and facilities for diagnosis, management and care. They should work closely with NGOs that are already providing these services or are willing to do so. These institutions should take full advantage of local human and veterinary health care traditions. The village community should share control with the Government over the health care delivery system and contribute towards its operational costs.

9.7 Education and information systems

Since good management of natural resources is intimately related to good management of information pertaining to the local resource base, the village community institutions involved in the management of natural resources and public health should also be responsible for primary, secondary, vocational and non-formal education. Both the formal and nonformal systems of education at the village (as also town and city) level should have significant components of interactive learning with the students and teachers involved in monitoring the status of the local environment with special reference to biological diversity resources and the public health situation. Such efforts in monitoring and preparation of management plans for local environment and health care, should lead to the preparation and annual updating of documents that may be termed "People's Environment Registers" (PER). Along with technical information from departments of agriculture, horticulture, animal husbandry, soil conservation, forestry, fishery, public health etc. initial preparation and regular updating of PERs should provide the learning situation and material for formal as well as non-formal adult education. Vocational education should be designed to fit the local needs, infrastructure and natural resource availability with substantial inputs from the local community. It may particularly focus on sustainable harvests, marketing and value addition to local resources of biological diversity. The village community should make the fullest use of the information gathered through monitoring as an integral component of the educational process for devising plans for the management of natural resources and public health.

10
Spelling Out a Framework

10.1 Role of *grama sabha*

As has been provided for in the Extension of Panchayats to the Scheduled Areas Act of 1996, the *grama sabha* of the village should be considered as the owner of all natural resources, especially biological diversity resources and knowledge of their uses in the public domain and as the final decision making body in the management of natural resources, health and education. The *grama sabha* should be authorized to regulate as well as levy fees on the collection of biological resources from public lands and waters within its jurisdiction. Benefits thus flowing from the utilization of natural resources should be equitably shared amongst members of the *grama sabha*. Such benefits may be treated as tradeable but a person's share in the collective property should be considered as inalienable. An elected or selected body termed as the Village Nature, Health and Education Committee (VNHEC) should function as a trustee for the management of this collective property. It should serve as the executive body implementing the decisions of the *grama sabha* and management plans prepared by it. The VNHEC should have adequate powers to regulate access by outsiders, as well as group members, and to make the needed operational rules for management, and equitable sharing of benefits. The VNHEC should prepare plans for the management of natural resources including biodiversity resources, health and education with participation and approval of the *grama sabha*. These village level plans should form the basis of a larger regional plan incorporating the management plans of other villages.

Government departments such as P.W.D. should not have a monopoly over executing works in the management plan, but should have to compete with private agencies and *grama sabha* members in winning contracts to do so. The VNHEC should closely monitor the implementation of such works and should have the powers to withhold payment in case of improper execution of works.

10.2 State and national level institutions

Several functions can be efficiently performed only at larger spatial scales above the village level such as taluk, or other appropriate regional grouping of panchayats, district, state or nation. For this purpose, representative committees should be formed at higher levels involving NHEC representatives from the preceding levels as members. Such committees should aid and support VNHECs in the following functions:

(a) Coordinate management of contiguous patches of forests, water bodies, hill ranges belonging to individual VNHECs;

(b) Organize sharing of indivisible, fugitive resources like surface and ground water, and natural biological populations based on traditional arrangements and current requirements;

(c) Deal with transboundary issues such as downstream influences and prevention of offences;

(d) Disburse funds to VNHECs and also receive payments for certain services rendered by them to the larger society like conservation of biodiversity, monitoring of status of crop pests and vectors of contagious diseases and participatory environmental impact assessment;

(e) Ensure redressal of grievances of weaker sections and protection of their interests;

(f) Organize evaluation of performance including, in particular, conservation of biodiversity, of individual VNHECs by an independent agency and allocation of funds on this basis;

(g) Resolve disputes amongst lower level committees;

(h) Provide advice and facilities to ensure that VNHECs get a fair price for market transactions involving surplus biomass, rocks, minerals, and intellectual property.

Such an institution capable of handling the multi-dimensional agenda advocated here will take time to develop; it would therefore be desirable to initiate the system by focusing it on the management of biological diversity resources.

These institutions should function in close coordination with panchayat raj institutions at village cluster, taluk and district levels and with state and central governments and should include the elected members of such bodies at the respective levels along with VNHEC representatives. VNHEC should have primacy in all aspects of ownership and management of its collective property unless it violates the norms to be established by the district level panchayat body, the Zilla Panchayat. A good first step in the process of organizing these institutions could be the establishment of Biodiversity Councils at the District, State and National levels.

10.3 Redefining the role and powers of government agencies

Currently, natural resources, health and education are separately managed in a centralized manner by various government agencies and departments. The role and powers of these Government agencies should be so redefined as to support the activities of VNHEC and be a part of an integrated, decentralized process of planning, implementation and management of natural resources including, especially, biological diversity resources, health and education. The development departments concerning natural resources like forest, agriculture, horticulture, animal husbandry and fisheries should provide technical expertise and training. They should constitute one of several possible implementation agencies for the management plans prepared by the VNHEC and consolidated at panchayat level. Relevant departments concerned with law enforcement regarding natural resources like forest, revenue, pollution control, or coast guard should depute their officers to form Nature Protection Squads. Control over and maintenance of such Nature Protection Squads should be shared by the district level NHEC body and the state government. Such Nature Protection Squads could start working immediately under the supervision of the District and State Biodiversity Councils.

10.4 Legal support

Environmental offences should be defined in the light of the norms and laws at state and national level. These laws should be appropriately broadened to support conservation of biological diversity, assertion of national sovereignty over these resources and equitable sharing of the benefits of utilization of biodiversity resources with local communities. However there should be enough

flexibility allowed at various levels to define offences and penalize offenders to suit the local context. The scope of the offences should be widened to include pollution, and commercial overexploitation.

Adequate provisions should be made for the protection of the interests of weaker sections by providing forums for redressal of grievances at appropriate levels. All activities of VNHEC and higher committees should come under the purview of the sub committee on welfare of weaker sections of the respective panchayat bodies and other relevant institutions at state and national level.

All conflicts between NHECs should be resolved by higher committees only. It would be desirable to constitute Nyaya Panchayats at the panchayat level as per Karnataka 1983 act with all activities of VNHEC and the panchayat level NHEC body within its jurisdiction. From taluk level upwards appropriate legal courts should perform this function. Special benches should be constituted for speedy disposal of cases. More immediately, mechanisms of conflict resolution in relation to biological diversity resources may be established through the agency of District Biodiversity Councils and appropriate tribunals.

10.5 Managing funds

Allocation of funds to VNHEC should be based on the performance as evaluated by the local pre-university and college students and teachers. Parameters for evaluating performance of VNHEC should be defined and weights assigned to each parameter for management of natural resources especially including conservation or enhancement of biological diversity resources, as well as performance with respect to health and education with appropriate inputs from district, state and national level. Payments to VNHECs should be enhanced to reward good performance and withheld in the case of very poor performance. Persistent bad performance should result in the takeover of the management of the VNHEC by higher level bodies until the VNHEC can ensure good performance. There needs to be internal auditing and evaluation of performance to scrutinize the utilization of funds by VNHEC and higher bodies. There should be no auditing by the government.

10.6 Ingredients of success

There should be a National Environmental Commission consisting of NHEC representatives, NGOs and scientists functioning as an independent authority

to: (a) adjudicate over matters affecting natural resources, public health, pollution, displacement of people by development projects, commercial exploitation etc. (b) continuously monitor status of environment and health at the national level. The establishment of a National Biodiversity Council could be a first step in this direction.

Adequate access to and dissemination of information is crucial to the success of this system. All VNHEC members and NHEC functionaries should have full right of information regarding any activity of NHEC at all hierarchical levels. Grassroots level awareness of the provisions of concerned legislation, status of natural resources, health, management plans, budget allocations, evaluation reports of VNHEC, and the working of higher committees are important for the success of the programme.

The system envisages the involvement of several institutions including NHECs at various levels of hierarchy, people's elected representatives, government departments, NGO and commercial interests in the management of natural resources, health and education. In this set up, it is important to ensure that the balance of power favours VNHEC and panchayat level institutions.

As the proposed system is based on democratization and decentralization of power across the board, it is bound to face resistance from certain sections of government and vested interests and initially apathy from people. In order to overcome these hurdles it will have to be built up step by step as a people's movement, with successful implementation of the system as a part of the grass roots political agenda. Biodiversity resources would be an ideal initial focal concern to start building up this system.

Decentralization of powers down to the village settlement levels would undoubtedly permit dominant social elements at such levels to exert their influence. The system as proposed here provides several checks and balances to minimize the distorting effects of such influences. In the more open, transparent processes thus visualized, the role of these influences should in any case be reduced in comparison with the role they can and do play in the current system.

10.7 Setting conservation priorities

Performance linked rewards to local communities for maintaining or enhancing the levels of local biodiversity resources is a critical, innovative component of this system. Local communities would have their own traditional systems of valuing biodiversity, based on utility, culture, religion. The values may change with time, as when allopathic drugs supplement the use of herbal remedies or market forces lead to weakening of taboos against cutting down sacred trees or groves. The local systems would then be inadequate guides to organizing a national, or a global effort at conservation of biodiversity. It is therefore necessary to set priorities at a higher level and to ensure that these provide the framework for local conservation efforts. Such priorities may be set at many different scales; with reference to specific genes, individuals of specific species, specific types of ecological habitats and so on. In general, elements representing more isolated evolutionary lineages, with restricted geographical ranges, under greater threats of extermination and of greater economic utility would tend to be valued more (Box 11: Assigning conservation priorities). Establishment of such priorities is a technical exercise and might have to be organized under the supervision of a technical body such as the National Biodiversity Council, or at the global level the Subsidiary Body on Scientific, Technical and Technological Advice to the International Convention on Biological Diversity. It is, however, important that the process be transparent and that the relevant information from such an exercise of setting conservation priorities ultimately reaches local communities. Educational institutions at various levels ranging from universities to village primary schools and Panchayati Raj institutions could play a vital role in this process. Indeed information on the conservation value of different species of living organisms or different types of habitats could constitute an important component of the environmental education curriculum at all levels.

10.8 Formulating appropriate incentives

Armed with information on conservation values of different elements of local ecology, and with authority to manage public lands and waters in their immediate neighbourhoods, local communities could design management strategies that would preserve, even enhance the total conservation value of biological

Box 11

Assigning conservation priorities: Valuing Bird Taxa

Assigning conservation priorities would be an exercise of quantifying the effort that the society might be willing to devote to ensure continued persistence of any given species. This would depend on a variety of attributes of the species. They belong to three major categories; rarity, extent of threat of extinction and utility. In general, rarer the species, the more threatened the species, the greater the utility of the species, the greater the effort that would be merited to ensure its continued persistence.

We may then assign to any particular species a conservation value reflecting this effort, such that the value would increase with rarity, extent of threat and utility. The actual values could either be ranks along a scale or a specific number. For the moment, we leave out utility and assign quantitative values ranging between 0 and 1 on the basis of 7 attributes relating to rarity and extent of threat. As a concrete example consider bird species of Western Ghats characterized by 7 values. Four of these values relate to the geographical range: G1, over the entire world divided into 6 zoogeographic regions; G2 over the oriental region divided into 9 subregions; G3 over the Indian subregion divided into 8 provinces; and G4 over the Malabar (Western Ghats plus West coast) province divided into 4 sections. The conservation value for a taxon by geographic range may be given as:

$G = (N-a)/(N-1)$

where N is the number of subdivisions at a given level and a is the number of subdivisions from which the taxon is known. This ensures that the more restricted the range on any of these scales, the greater would the conservation value be. The conservation value of each taxon by habitat preference may be computed as

$H = (N-a)/(N-1)$

where N, is the total number of bird habitat types over the Western Ghats

region and a the number of habitats favoured by a given taxon. This ensures that the more limited the habitat range of a species, the greater would the value be. The conservation value of a taxon reflecting its taxonomic distinctness may be calculated as:

$T = 1/(a \times b)$

where a is the number of species known in the family to which the taxon belongs and b is the number of races under the species. Rarity is thus sought to be captured in terms of narrowness of geographical range, narrowness of habitat preference and limitations on number of related taxa. The conservation value by degree of endangerment may be assigned as $E = p$

where p is the proportion of endangered taxa in the family to which the taxon belongs.

Admittedly these attempts to capture rarity and endangerment in terms of broad patterns of geographical distribution, habitat preferences, taxonomic position and number of related taxa recorded as threatened are crude. Nevertheless they are based on information which is available for all bird species of Western Ghats, indeed of the whole country, and therefore permit of an evaluation exercise which is reasonably objective and accessible for verification by all who may be interested. This overcomes problems which plague other more subjective exercises, including the listing of threatened species in IUCN sponsored red data books. Thus the peafowl *(Pavo cristatus)*, the Nilgiri Wood Pigeon *(Columba elphistonii)*, lesser adjutant stork *(Leptoptilos javanicus)* and the redfaced malkoha *(Phaenicophaeus pyrrhocephalus)* are the 4 Western Ghats species included in the list of endangered species. However of these four the peafowl is widely distributed in India with many pockets of local abundance thanks to religious beliefs and the lesser adjutant stork is locally quite common in its appropriate habitat.

We have computed for the set of 586 species of Western Ghats conservation values for each of these 7 parameters, and a composite conservation value (CCV) as the sum of four values, namely the mean of the four values

derived from geographical distribution and the other three values related to habitat preference, taxonomic uniqueness and degree of endangerment. As Table 11.1 shows, the CCV ranges between 0.66 for the Indian jungle crow, widespread, habitat generalist, a member of a family with many species, and a species with many races and of a family in little danger of extinction to 2.77 for crab plover, a wader with a restricted geographical distribution, narrow habitat preferences, and the only species in the family Dromadidae. The cumulative frequency distribution rises rapidly at either end, between 0.66 to 1.11 and between 1.94 to 2.77, with about 520 species in the middle accounting for the values between 1.11 to 1.94. The bottom 22 and top 21 species with composite values substantially higher or lower than the majority are then of special interest. Fifteen out of these are birds of aquatic habitats, egrets, cormorants, cranes or skuas. Since our focus is on terrestrial habitats, we may take a closer look at the other species (see Table 11.1). The species with the highest conservation value include thrushes, babblers, woodpeckers, trogon, characteristic of forest habitats with narrow ranges at least at the subspecies level; and gallinaceous birds (quails, junglefowls etc.) that are extensively hunted and thereby threatened. The species with the lowest conservation values include passerines, swallows, hawks and falcons with a broad range of habitat tolerance and a wide geographical distribution, many of whom have adapted to human presence.

Table 11.1: Conservation Values of 28 selected species of birds from 586 species of Western Ghats

HB No	Species	Rank	CCV	G1	G2	G3	G4	H	T	E
1063	Grey Hypocolius	2	2.28	0.80	0.00	1.00	1.00	1.00	0.33	0.00
260	Rock Bush Quail	4	2.08	1.00	1.00	0.85	1.00	1.00	0.00	0.11
277	Red Spurfowl	5	2.07	1.00	1.00	1.00	1.00	0.95	0.00	0.11
1638	Whitebellied Shortwing	7	2.02	1.00	1.00	1.00	1.00	1.00	0.00	0.02
1637	Rufousbellied Shortwing	7	2.02	1.00	1.00	1.00	1.00	1.00	0.00	0.02
299	Indian Red Junglefowl	11	1.99	1.00	1.00	0.85	1.00	0.91	0.00	0.11

HB No	Species	Rank	CCV	G1	G2	G3	G4	H	T	E
599	Redfaced Malkoha	12	1.99	1.00	0.87	1.00	1.00	1.00	0.01	0.01
1220	Mount Abu W.T. Babbler	13	1.99	1.00	1.00	0.85	1.00	1.00	0.00	0.02
710	Trogon	14	1.98	1.00	1.00	0.85	1.00	1.00	0.01	0.01
1135	Yellowthroated Bulbul	15	1.97	1.00	1.00	0.85	1.00	1.00	0.01	0.00
1756	Bourdillon's Blackbird	16	1.97	0.80	1.00	1.00	1.00	1.00	0.00	0.02
853	Pigmy Woodpecker	19	1.95	1.00	1.00	1.00	0.66	1.00	0.00	0.03
614	Striated Scops Owl	20	1.94	0.80	1.00	0.85	1.00	1.00	0.01	0.02
1874	Forest Wagtail	542	1.09	0.80	0.37	0.14	0.00	0.73	0.02	0.00
135	Brahminy Kite	543	1.09	0.80	0.25	0.00	0.00	0.78	0.00	0.04
953	Indian Golden Oriole	545	1.08	0.60	0.62	0.42	0.00	0.65	0.02	0.00
748	Bluetailed Bee-eater	547	1.07	1.00	0.00	0.28	0.00	0.74	0.01	0.00
130	Crested Honey Buzzard	549	1.04	0.80	0.25	0.00	0.00	0.74	0.00	0.04
750	Small Green Bee-eater	553	1.00	0.60	0.87	0.42	0.00	0.52	0.00	0.00
209	Peregrine Falcon	554	0.99	0.00	0.37	0.00	0.00	0.87	0.00	0.03
124	Blackwinged Kite	555	0.99	0.40	0.12	0.14	0.00	0.78	0.00	0.04
1884	Grey Wagtail	556	0.98	0.60	0.00	0.00	0.00	0.83	0.00	0.00
1006	Indian Myna	557	0.93	0.20	0.50	0.14	0.00	0.70	0.00	0.02
1407	Brown Flycatcher	558	0.90	0.80	0.00	0.28	0.00	0.61	0.00	0.02
917	Eastern Swallow	560	0.86	0.00	0.12	0.00	0.00	0.83	0.00	0.00
965	Indian Grey Drongo	561	0.85	0.80	0.75	0.42	0.00	0.35	0.00	0.00
736	W.B.Kingfisher	562	0.73	0.80	0.62	0.57	0.00	0.22	0.00	0.01
1057	Indian Jungle Crow	563	0.66	0.80	0.87	0.71	0.00	0.04	0.00	0.02

HBNo= Reference number of species in Ali and Ripley's (1983) Handbook of Birds of India and Pakistan.A

CCV = Composite Conservation Value.

Rank= Rank of the species according to its CCV.

G1, G2, G3, G4, H, T, E as in the text.

communities within their territories. We believe that local communities in continual touch with the local biological communities would be well equipped to do so. They could be motivated to continually adjust their resource use strategies in the interest of biodiversity, provided that they are adequately rewarded. The perceptions of local people as to the adequacy of such external rewards would to a great extent depend on their ability to directly benefit from biodiversity in other ways. An important component of rewards for conservation efforts could then be building the capacity of local communities to add value to local biodiversity. This may, for instance, involve preparing alcohol extracts of ingredients used in pharmaceutical industry, or organizing ecotourism. Over and above this, the local communities may need to be compensated for foregoing economically more rewarding opportunities in uses of land or water within their territory. Exactly what level of rewards the local communities receive and what level of conservation effort they put in would depend on the demand for conservation generated at the national or global level, and the supply of conservation effort offered at the local levels. However, such a system ought to deliver conservation effort in a far more cost effective manner than the current system of investing in regulatory efforts by a bureaucracy which is not accountable for what it ultimately delivers, and which has established an adversarial relationship with the local people.

This approach to conservation of biodiversity is then fundamentally different from the prevailing approaches in the premise that conservation is compatible with prudent use. We believe that such prudent use should, in turn, generate financial resources which should be used to create positive incentives for local communities to maintain, or better still enhance local levels of biodiversity. To operationalise this approach then we must also examine the whole issue of value addition to biodiversity resources, in the context of modern technological advances, as well as the new regimes of intellectual property rights and a nation's sovereign property rights over its biodiversity resources.

11
The International Context

11.1 No longer a common heritage

India, along with most other countries of the world, is now a party to the General Agreement on Tariffs and Trade (GATT) with its provisions relating to Trade Related Intellectual Property Rights (TRIPS). This commits us to accept intellectual property rights over biochemicals as products, as well as over cultivated plant varieties, microorganisms and microbiological processes. There is considerable scope for very wide interpretation of these terms, so that human cells in cultures, as also isolated genes, may be deemed as microorganisms. Going even further, contrary to the conventional practice that IPR is to be granted only to new inventions, U.S.A. is beginning to grant it over simple discoveries, such as nucleotide sequences of specific genes. Indeed the U.S. Supreme Court has declared that IPR may be granted over "anything under the sun made by man", and U.S.A. will do its best to persuade all signatories to GATT to accept a very wide range of IPRs over biological materials in the coming years. It is likely that India would find it impossible to resist such pressures. It is then in our interest to foresee this contingency and work out ways and means of turning the situation to our advantage instead of merely continuing to condemn these developments, while being unable to actually contain them.

While India may boast of being a country with the world's third largest scientific manpower, it has a very poor record of technical innovations. Most of the biotechnologies have been developed in the industrial countries, in U.S.A., Western Europe and Japan. But India, along with countries like Brazil, Malaysia, Indonesia, China and Australia does harbour a much greater stock of genetic resources than do these industrial countries (Box 3). This includes wild resources, as well as genetic variations in cultivated plants and domestic livestock.

Access to these biodiversity resources is vital to continuing growth of biotechnologies and industrial countries would like to ensure that they do have

Box 12

CBD
Article

15

Access to Genetic Resources

1. Recognizing the sovereign rights of States over their natural resources, the authority to determine access to genetic resources rests with the national governments and is subject to national legislation.
2. Each Contracting Party shall endeavour to create conditions to facilitate access to genetic resources for environmentally sound uses by other Contracting Parties and not to impose restrictions that run counter to the objectives of this Convention.
3. For the purpose of this Convention, the genetic resources being provided by a Contracting Party, as referred to in this Article and Articles 16 and 19, are only those that are provided by Contracting Parties that are countries of origin of such resources or by the Parties that have acquired the genetic resources in accordance with this Convention.
4. Access, where granted, shall be on mutually agreed terms and subject to the provisions of this Article.
5. Access to genetic resources shall be subject to prior informed consent of the Contracting Party providing such resources, unless otherwise determined by that Party.
6. Each Contracting Party shall endeavour to develop and carry out scientific research based on genetic resources provided by other Contracting Parties with the full participation of, and where possible in, such Contracting Parties.
7. Each Contracting Party shall take legislative, administrative or policy measures, as appropriate, and in accordance with Articles 16

and 19, and where necessary, through the financial mechanism established by Articles 20 and 21 with the aim of sharing in a fair and equitable way the results of research and development and the benefits arising from the commercial and other utilization of genetic resources with the Contracting Party providing such resources. Such sharing shall be upon mutually agreed terms.

Article

16

Access to and Transfer of Technology

1. Each Contracting Party, recognizing that technology includes biotechnology, and that both access to and transfer of technology among Contracting Parties are essential elements for the attainment of the objectives of this Convention, undertakes subject to the provisions of this Article to provide and/ or facilitate access for and transfer to other Contacting Parties of technologies that are relevant to the conservation and sustainable use of biological diversity or make use of genetic resources and do not cause significant damage to the environment.

2. Access to and transfer of technology referred to in paragraph 1 above to developing countries shall be provided and/ or facilitated under fair and most favourable terms, including on concessional and preferential terms where mutually agreed, and, where necessary, in accordance with the financial mechanism established by Articles 20 and 21. In the case of technology subject to patents and other intellectual property rights, such access and transfer shall be provided on terms which recognize and are consistent with the adequate and effective protection of intellectual property rights. The application of this paragraph shall be consistent with paragraphs 3, 4 and 5 below.

3. Each Contracting Party shall take legislative, administrative or policy measures, as appropriate, with the aim that Contracting

Parties, in particular those that are developing countries, which provide genetic resources are provided access to and transfer of technology which makes use of those resources, on mutually agreed terms, including technology protected by patents and other intellectual property rights, where necessary, through the provisions of Articles 20 and 21 and in accordance with international law and consistent with paragraphs 4 and 5 below.

4. Each Contracting Party shall take legislative, administrative or policy measures, as appropriate, with the aim that the private sector facilitates access to, joint development and transfer of technology referred to in paragraph 1 above for the benefit of both governmental institutions and the private sector of developing countries and in this regard shall abide by the obligations included in paragraphs 1, 2 and 3 above.

5. The Contracting Parties, recognizing that patents and other intellectual property rights may have an influence on the implementation of this Convention, shall cooperate in this regard subject to national legislation and international law in order to ensure that such rights are supportive of and do not run counter to its objectives.

Article

17

Exchange of Information

1. The Contracting Parties shall facilitate the exchange of information, from all publicly available sources, relevant to the conservation and sustainable use of biological diversity, taking into account the special needs of developing countries.

2. Such exchange of information shall include exchange of results of technical, scientific and socio-economic research, as well as information on training and surveying programmes, specialized knowledge, indigenous and traditional knowledge as such and in

combination with the technologies referred to in Article 16, paragraph 1. It shall also, where feasible, include repatriation of information.

Article

18

Technical and Scientific Cooperation

1. The Contracting Parties shall promote international technical and scientific cooperation in the field of conservation and sustainable use of biological diversity, where necessary, through the appropriate international and national institutions.

2. Each Contracting Party shall promote technical and scientific cooperation with other Contracting Parties, in particular developing countries, in implementing this Convention, *inter alia*, through the development and implementation of national policies. In promoting such cooperation, special attention should be given to the development and strengthening of national capabilities, by means of human resources development and institution building.

3. The Conference of the Parties, at its first meeting, shall determine how to establish a clearing-house mechanism to promote and facilitate technical and scientific cooperation.

4. The Contracting Parties shall, in accordance with national legislation and policies, encourage and develop methods of cooperation for the development and use of technologies, including indigenous and traditional technologies, in pursuance of the objectives of this Convention. For this purpose, the Contracting Parties shall also promote cooperation in the training of personnel and exchange of experts.

5. The Contracting Parties shall, subject to mutual agreement, promote the establishment of joint research programmes and joint ventures for the development of technologies relevant to the objectives of this Convention.

Article

19

Handling of Biotechnology and Distribution of Its Benefits

1. Each Contracting Party shall take legislative, administrative or policy measures, as appropriate, to provide for the effective participation in biotechnological research activities by those Contracting Parties, especially developing countries, which provide the genetic resources for such research, and where feasible in such Contracting Parties.

2. Each Contracting Party shall take all practicable measures to promote and advance priority access on a fair and equitable basis by Contracting Parties, especially developing countries, to the results and benefits arising from biotechnologies based upon genetic resources provided by those Contracting Parties. Such access shall be on mutually agreed terms.

Article

22

Relationship with Other International Conventions

1. The Provisions of this Convention shall not affect the rights and obligations of any Contracting Party deriving from any existing international agreement, except where the exercise of those rights and obligations would cause a serious damage or threat to biological diversity.

2. Contracting Parties shall implement this Convention with respect to the marine environment consistently with the rights and obligations of states under the law of the sea.

such access in the years to come (see Box 12). The industrial countries are also concerned that these genetic resources are being rapidly eroded due to the destruction of natural biological communities, and replacement of diverse land races of domesticated plants and animals by a few high yielding varieties in the developing countries. The industrial countries are therefore very much interested in persuading gene rich developing countries such as India to maintain open access to the country's genetic resources, and to make a commitment to conserve them. Developing countries, on the other hand, want to ensure that the benefits of utilization of their biological resources do not all flow to the industrial countries. At the United Nations Conference on Environment and Development held at Rio de Janeiro in June 1992, countries like India, Brazil and Malaysia, succeeded in including some principles of benefit sharing in the Convention on Biological Diversity (CBD). These include an acknowledgment that biological diversity resources will now be treated as a sovereign property of the country of origin. This is a major shift because till now these resources have been treated as a common heritage of mankind.

It is under such a regime that genetic resources of cultivated crops like wheat and rice have been collected from all the countries of the world, freely exchanged and pooled together in various germplasm collections such as the rice germplasm collection at the International Rice Research Institute in Philippines. Amongst the large number of strains so collected is a cultivar from Pattambi in Kerala. Some years ago the rice crop over much of southeast Asia was threatened by an outbreak of an insect pest called brown plant hopper. It turned out that of all the thousands of strains screened this Pattambi strain carried a gene conferring resistance to the brown plant hopper. The gene was then incorporated in the high yielding varieties and saved rice crops worth crores of rupees in southeast Asia. Since the Pattambi gene was then considered a common heritage of mankind, there was no question of India deriving any specific benefits from the use of this gene, or of such benefits being shared with the farmers who had developed and nurtured this variety over the years.

11.2 Sovereign property

Under the new regime introduced by CBD, genetic resources such as the Pattambi gene for resistance to brown plant hopper are a sovereign property of the country of origin—in this case, India. As a party to the Convention,

India is committed not to block access to such resources. But access by interested parties has to be on the basis of India's prior informed consent and on mutually agreed terms. Developing countries of origin that make such biodiversity resources available are to benefit from the transfer in several ways. They are expected to receive technologies based on their biodiversity resources through transfer agreements on concessional terms (Box 12 : Convention on Biological Diversity, articles 15, 16, 17, 18, 19, 22). Research and development activities involving such genetic resources are also to be preferentially located in the countries of origin. They may also claim royalties and other financial benefits. Furthermore, the countries of origin are expected to share these benefits with indigenous people who have participated in the conservation and development of such biodiversity resources. The countries of origin are also expected to prepare adequate inventories of their biodiversity resources, monitor their fate and strive towards their long term conservation.

India, a megadiversity country with a wealth of biodiversity resources has much to gain from the CBD provisions (see boxes 2, 12) because, it has

- a wealth of practical ecological knowledge of how to use and manage these resources among its fisherfolk and farmers, tribals and basket weavers living close to the earth;
- rich classical traditions of use and management of resources, such as Yunani and Ayurveda systems of medicine and Vrikshayurveda system of care and propagation of medicinal plants;
- excellent scientific capabilities in systematic biology, conservation biology, genetic and plant breeding, biotechnology.

Operationalising these provisions is however a difficult and complicated task. It is also a task that needs to be addressed urgently for time is slipping by. The Convention on Biological Diversity was first signed by 157 countries at Rio de Janeiro in June 1992. Over 30 countries had ratified it by December 1993 when it came into force. India ratified and became a party to the Convention in February 1994. The Parties to the Convention had their first Conference in Bahamas in November 1994, the second in Indonesia in November 1995, the third in Argentina in November 1996, and the fourth in the Czech republic in May 1998.

By now over 160 countries have ratified the Convention on Biological Diversity. These include all the major industrial as well as developing nations of the world, including Japan, Germany, France, U.K., Canada, Australia, Brazil, China, Indonesia, Malaysia and India. The one exception is U.S.A. which has signed, but has not as yet ratified the Convention. That is one indication of the serious problems that countries like India face in operationalising the provisions of the Convention in their own interest. The industrial countries, in particular U.S.A., would like to see that the provisions relating to sharing of benefits with developing countries of origin as well as indigenous communities have no teeth to them. On the other hand, neither India, nor our allies like Brazil and Malaysia arguing for inclusion of benefit sharing arrangements in the Convention, have put in sufficient efforts to ensure that the provisions are operationalised. We must do so urgently, or run the risk of failing to put any benefit sharing arrangements in place.

There are then two concerns that must be addressed by us, one immediate, and one in the longer term. The immediate concern is for India to come up with well thought out concrete proposals for operationalising the benefit sharing arrangements of the convention. It is necessary that these are fully discussed with other developing countries, and an international consensus arrived at as early as possible. In the longer term, we must plan on how we can sustainably use our rich genetic resources capitalizing on our strengths in knowledge based enterprises. The long term plan needs to be prepared hoping for favourable arrangements for benefit sharing, but also recognizing that industrial countries may successfully sabotage the efforts of the developing countries in this direction.

12
Protecting Our Interests

12.1 A promotional approach

India's approach to the question of how to protect our interests in the biodiversity resources that are now our sovereign property may either emphasize regulatory, or promotional measures. The regulatory measures would focus on denying access to our biodiversity resources, and to information pertaining to their location, properties and uses to outsiders. The thrust of the promotional measures would be to develop good information on our biodiversity resources, make it widely and easily accessible and make its use attractive to both Indian and foreign enterprises. This approach would facilitate easy access not only to information, but to the material resources as well, on the basis of reasonable material and information transfer agreements and while charging appropriate fees for access to information and material resources. We may then use the funds so generated to build our own scientific and entrepreneurial capabilities, to reward our people living close to nature for their conservation traditions, and knowledge of sustainable use of living resources, and to motivate them to continue to conserve our heritage of biodiversity. We believe that the promotional approach is desirable on many grounds.

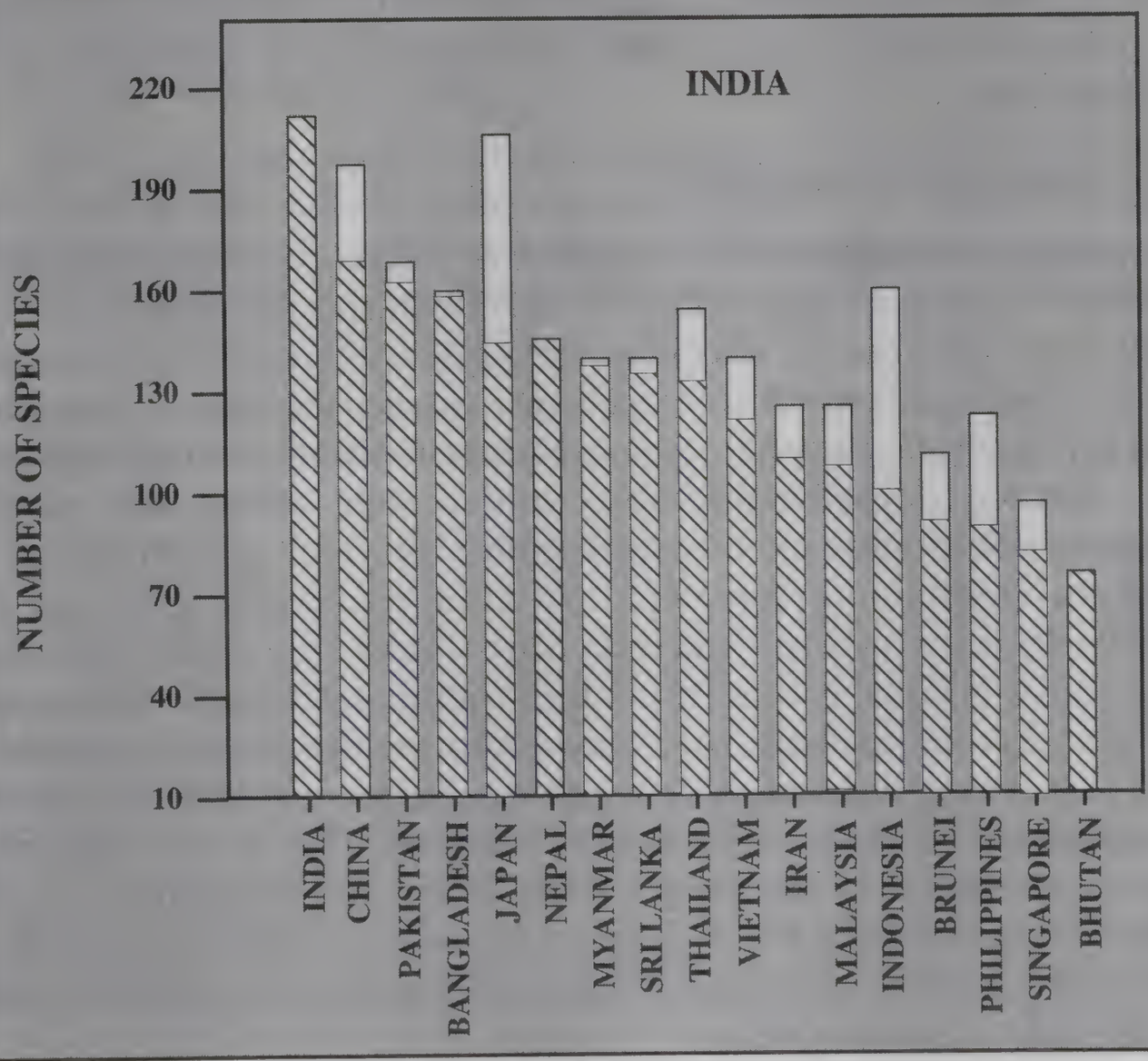
Most pertinently, of course, an exclusively regulatory approach will simply not work for a number of reasons.

- Firstly, a fair amount of our biological material, and most of the scientific information relating to these resources is already in the hands of industrial countries.

- Secondly, another large fraction is shared with neighbouring countries such as Pakistan, China, Bangladesh, Nepal, Bhutan, Sri Lanka and Myanmar (Box 13: The total numbers of waterbird species and species shared with India amongst India's 16 Asian neighbours). These countries may not all co-operate with us in maintaining a monopolistic hold on these resources.

Box 13

To what degree does India share its wealth of living diversity with other countries? Some clues may be obtained by looking at waterbirds, perhaps the best known group of all organisms. Regular censuses of waterbirds have been held every year in most Asian countries since 1987. This provides an excellent set of information on the distribution of 326 species of such birds in 17 Asian countries. India harbours the largest number, 213 of these 326 species, Japan comes next with 206, landlocked Bhutan has the smallest number, 80. Figure 13.1 shows the total number of species present in these 17 countries and the numbers of species shared with India. As might be expected, of all its neighbours, India has the largest proportion of species present in Bhutan; while China leads our neighbours in the number of Indian species present in that country.



- Thirdly given our large trade in biological produce, it is very difficult to control ongoing export of biodiversity resources. If we want to sell Basmati rice to U.K., there is no way to prevent a U.K. based company from using this material to isolate the chemical compound responsible for the delicate aroma, or the genes responsible for the production of the compound.
- Finally, only small quantities of biodiversity resources need to be taken out, and to prevent their being smuggling out is well nigh impossible. After all, history tells us that in spite of their best efforts, Peru could not prevent cinchona seeds from being smuggled out, nor could Brazil prevent rubber seeds leaving the country. Today, a single hair pulled out from its root is enough to make any number of copies of the genetic material of a human being, or an antelope or a lion, and literally thousands of such hairs with their living roots could be carried in a small vial in a coat pocket. Guarding against smuggling of genetic material is therefore a completely hopeless proposition.

12.2 North-south co-operation

A workable system must therefore depend on mutual co-operation amongst countries of south and north, with both sides facilitating the fullest use of the biodiversity resources in a sustainable fashion, accompanied by a building up of the technological capabilities of the south, and equitable sharing of benefits between countries as also with local communities inhabiting gene rich localities. This calls for (a) biodiversity rich countries openly sharing their genetic resources and pertinent information regarding their uses, and (b) industrial countries agreeing to a transparent system of acknowledging the use of biodiversity resources from biodiversity rich countries. This would require that all countries maintain open access to their territories, and public collections and specially constituted data bases, provided that those accessing the resources fully acknowledge and reasonably compensate for any use/export of material or information pertaining to biodiversity resources. This must be supported through all countries by organizing a system of recording of import and export of biodiversity resources. For this purpose, it is necessary to adequately define biodiversity resources, in a broader sense to include use of biochemicals such as alkaloids or esters as well.

12.3 Defining biodiversity resources

We suggest the following as an appropriate set of criteria for this purpose of defining biodiversity resources:

(a) Biological material serving as a source of scientific information, which may not necessarily be put to any immediate commercial use, e.g. herbarium or museum specimens, blood samples, samples of seeds in cryoscopic storage, etc.

(b) Biological material serving as an input for creating improved sources of a recognized commercial product through breeding or other intervention, e.g. as a source of disease resistance in a crop.

(c) Biological material serving as an input to a source of some new commercial product through breeding or other intervention, such as a food additive.

(d) Biological material serving as a source of a new commercial product, such as vegetable dye or a drug.

Similarly it would be desirable to record access to informational resources that promote such function of biodiversity resources. These may include both technical knowledge, and folk knowledge of propagation of a local cultivar with high levels of drought resistance, or use of a vegetable dye, or a fish poison, or a drug against hepatitis and so on.

13
Specifications—IPR and Country of Origin

13.1 Mandatory disclosure

Potentially the most effective source of information on the use of biodiversity resources is the intellectual property rights (IPR) applications, and India should do its best to persuade all countries to agree to include in their patent, or protected plant varieties legislation, a proper specification of the country/ies of origin and prior public knowledge of uses. The four universally accepted requirements for the patentability of any invention include : novelty, non-obviousness, usefulness and adequate specification. Every IPR application must disclose details of the invention with the help of an IPR specification that describes an invention in sufficient detail to: (i) allow the patent office, and other interested parties to assess its claims of novelty, non-obviousness and usefulness; and to (ii) allow a person skilled in the art to reproduce it. Such a specification or disclosure statement has to accompany, or shortly follow every IPR application.

Patent legislation has historically developed in relation to mechanical and chemical innovations. The specification requirements for innovations involving the use of biological materials are however, only now beginning to evolve, primarily through judicial interpretations. Such interpretations have resulted in the requirement of deposition of the appropriate living material in an internationally recognized repository such as the Fermentation Research Institute of Japan or the European collection of Animal Cell Cultures in the United Kingdom. But there is no clear-cut understanding today that the specification must include fuller details regarding the biological material such as the country of origin. Nor is there so far any formal acknowledgment of the need to accord recognition to community based knowledge. However, many patent specifications do voluntarily provide such information. Thus European Patent 0010061 A1 800416 concerning novel pharmaceutical preparations containing

an extract of the mollusc *Perna canaliculus* states it to be found on the shores of New Zealand. In the case of American Patent 05298251 (1992) regarding fungicides derived from neem oil, there is a mention of prior knowledge of communities regarding its uses.

Evidently, a further nominal increase in the formal requirements of the specification would admirably serve the purpose of providing information relating to the countries of origin and local communities involved in sustainable use of the concerned biological resources. The proposed requirement should not only cover inventions which result in living material, such as a microorganism isolated in a culture, seed of a variety of cultivated plant, or a transgenic animal; it should also cover other products dependent on biological sources, such as alkaloids derived from plants and used as therapeutic agents or pesticides. Furthermore, the requirement should also extend to products that are essentially derived from biological sources, for instance, a synthetic molecule that differs a little from but has the same aroma as sandal *(Santalum album)* and was inspired by it. In all these cases, the specification should include a clear mention of the biological source material, the known country or countries of origin of the material, and all known information including that pertaining to knowledge and practices of sustainable use of this specific biological source material by local communities in the country or countries of origin. This of course raises the very complex question of how to interpret the term country or countries of origin.

13.2 Distribution patterns of living organisms

Ascription of a country or countries of origin to any biodiversity resource is evidently related to the patterns of geographical distribution of living organisms; patterns that have been changing over geological and historical times. Certain groups of organisms are apparently ubiquitous in their distribution. This is likely to be the case with spore forming microorganisms. Thus most species of the slime mould genus *Dictyostelium* range over all continents and from tropics to arctics. However, such wide ranging species are likely to harbour considerable intraspecific genetic variation within their populations. It is therefore possible that specific genetic variants may be confined to one or few countries of origin. Other microorganisms commensalic with higher plants or animals

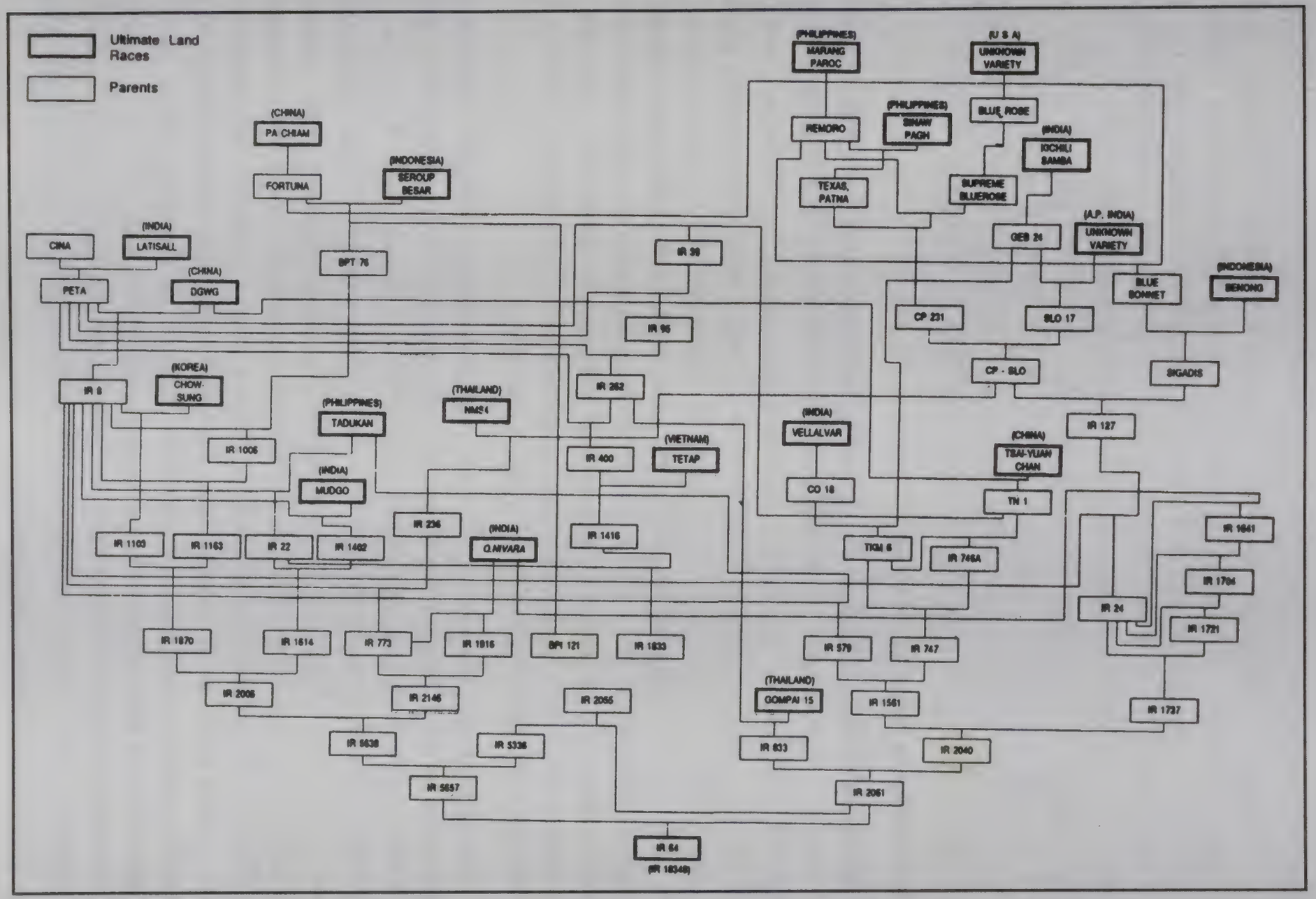
may have more restricted distributions. Thus the ectomycorrhiza *Tricholoma marsutaki* is known only from the host *Pinus densiflora* in certain specific habitats in Japan. Few higher organisms are ubiquitous, and most have distributions limited to one or few countries or had such distributions prior to the modern era of global transport that commenced around 1500 A.D. Many species of even highly mobile organisms like birds are endemic to just one country. Thus of 969 species of Indian birds, 69 are endemic, while of a total of 1519 species of Indonesian birds as many as 258 occur in no other country. Levels of endemism are higher in other, less mobile groups of organisms. Thus of 206 Indian species of amphibians as many as 110 are endemic, and of 270 Indonesian species, fully 100 are endemic.

The question of country of origin would also be complicated in case of organisms produced through human intervention from multiple lineages. Thus the high yielding rice variety IR 64 produced at the International Rice Research Institute in Philippines is based on genes from 20 landraces coming from 8 different countries namely China, India, Indonesia, Korea, Philippines, Thailand, U.S.A. and Vietnam (Box 14: Diagram on rice pedigree). The situation is apt to become even more complex in days to come. Already there exist transgenic organisms like *Nicotiana tabacum* with an endotoxin producing gene from *Bacillus thuringensis*. *Nicotiana tabacum* may be assigned to several tropical American countries as countries of origin, but *Bacillus thuringensis* has a worldwide distribution. How to deal with issues of geographical origin of such transgenics clearly calls for further thinking.

13.3 Dispersals

The greatest complication of all is the fact that living organisms have dispersed on their own, inadvertently through human agency, as well as deliberately through human efforts over many parts of the world. Such dispersal of course, continues to gather pace in a rapidly shrinking world. How should we then define the country of origin, say of the blue rock pigeon *(Columba livia)* which probably originated somewhere in the middle east, but is now distributed all over the world? Or what of chilli peppers *(Capsicum annuum)* which originated in south and central American countries including Mexico, Guatemala and Peru reaching India during Emperor Akbar's reign in early 1500's? By now chillies

Box 14



Twenty land races of traditional rice varieties from 8 nations are in the genetic ancestry of I R 64, released in May 1985

have been extensively cultivated in India over 5 centuries and have diversified into a number of indigenous cultivars. One such is the bright red Byadgi strain of Dharwad district of Karnataka, unusual in being cultivated in the monsoon season and in much demand as a source of the alkaloid capsaicin and for the red vegetable dye. It would be unfair to Byadgi farmers to treat Mexico or Peru as the countries of origin of all genetic resources of the chilli crop. But other species such as neem *Azadirachta indica* have been planted in only last few decades in several countries outside of its native home of India and Myanmar and have not diversified genetically in those countries, and it may not be reasonable to consider all such countries as countries of origin.

13.4 Defining country of origin

India might propose that the international community agrees to define a country of origin as that country in which a biological resource that has never been domesticated is known to have occurred under natural conditions at a certain cut off date. An appropriate cut off may be the beginnings of large scale global trade in 1500 A.D. Alternatively, it could be December 1993, the date on which the Convention on Biological Diversity came into force. Many domesticated species have spread since 1500 A.D. For them countries of origin may be all those countries in which the species had extensively diversified genetically by December 1993, as evident from depositions in recognized national or international collections of crop genetic resources.

The richest collection of crop genetic resources today is with the institutions belonging to the Consultative Group for International Agricultural Research (CGIAR) system. Thus today the collection of rice germ plasm at the International Rice Research Institute in Philippines may include strains of Indian origin that have gone out of cultivation in India with the introduction of high yielding varieties, and may not even be available with our own Rice Research Institute in Cuttack. However, by and large there is a proper record of the countries from which these strains have been obtained under the earlier regime that treated genetic resources as a common heritage of mankind. India should propose that in these cases the countries providing the strains must be treated as countries of origin. All applications for protection of plant varieties should mandatorily give credit to all the countries of origin that may have provided the genes for the concerned variety.

Whatever the ultimate resolution of this issue of assigning countries of origin to any biodiversity resource, it is very clear that India has a great deal to gain by working together with our neighbouring countries. Most of our neighbours are very rich in biodiversity resources, yet none of them have scientifically and technologically advanced to the level of the industrial countries of Europe, North America and Japan. These countries, therefore, have a hold on much of the scientific information, as well as actual specimens—preserved or maintained in botanical gardens or in gene banks—of the biodiversity resources of the Asian region. It is essential that we begin building our Asian regional capabilities in this regard, and then work out a scheme for repatriating much of the material back to the countries of the region. India is obviously in a position to take a lead in this context, though we have so far done little to build bridges with our Asian neighbours and establish programmes of scientific and technical collaboration with them.

14
A Global Framework

14.1 Clearing house facility

Specifications accompanying patent or other IPR applications are open to the public to varying degrees and after varying intervals following the filing of an application. It is suggested that this part of the specification relating to the biological source, country/ies of origin and knowledge and practices of sustainable use by local communities be open to full public scrutiny for an adequate period at the appropriate time after the filing of the IPR application. This would permit countries with possible claims as countries of origin, and as repositories of public knowledge and practices of sustainable use to examine the patent applications and make any submissions that they may wish to make. It would also permit other parties, such as NGOs interested in furthering the interests of local communities to make such submissions.

Such a system of specification in the IPR applications would make available the required information on country/ies of origin and prior common knowledge very easily and at no additional cost to any concerned party. The proposed "clearing house" serving CBD could organize collation of such information from the various countries and its full sharing (see Box 15 : The Clearing House Mechanism). This would be an excellent indication of the relative contribution of the genetic resources from different countries of the world to the development of biodiversity based enterprises.

The "clearing house" should go one step further and with the help of the Ministries of Industry in various countries collect information on the patents or protected plant varieties actually being worked in each country, and the country of origin of biological resources indicated in the IPR specifications. This would provide a very reliable indication of the relative contribution of the genetic resources from different countries to the actual economic activity of the biodiversity based enterprises.

Access to this information through the "clearing house" would permit all countries to gauge the dependence of enterprises in other countries on their

Box 15

CBD

Policy Aspects of the Clearing House Mechanism

11. The scope of the clearing house mechanism should be the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, through;

    a. providing an information exchange service that enhances the capacity of countries to cooperate on the development of policies and technologies through joint ventures and joint research programmes;

    b. developing and strengthening national capacity by serving as an instrument for the development of local, national and global policies on the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources;

    c. supporting and facilitating activities that Parties will undertake for the implementation of the Convention, with particular emphasis on the development and strengthening of institutional capacities;

    d. assisting countries to develop partnerships through joint ventures and joint research programmes in both the public and private sectors. The partnerships will take into account the need to use innovative ways of mobilizing financial resources for such joint ventures and joint research programmes;

    e. assisting the activities of the Secretariat by integrating and disseminating scientific, technical and technological information regarding the objectives of the Convention.

Source: *Agenda for SBSTTA meeting, Paris, September 4–8, 1995: Secretariat of Convention on Biological Diversity.*

genetic resources and the dependence of enterprises in their country on genetic resources from other countries. This would facilitate all countries mutually agreeing on location of R & D activities in countries of origin of genetic resources as well as on transfer of technology on special terms to countries of origin of genetic resources.

14.2 Biodiversity conservation fund

India as a nation state is already investing substantial amounts of state revenue in conservation efforts. Its population is further contributing by accepting costs of conservation, whether it be through foregoing some economically more attractive development options, or tolerating crop damage by elephants. What we propose is that these financial inputs be organized as a national biodiversity conservation fund, perhaps with contributions from international sources such as Global Environment Facility. These funds could then be rationally allocated to the various local communities spread across the nation in relation to the levels of conservation value of biological communities in their respective territories.

Over and above this, all countries could agree to levying a biodiversity conservation cess on (a) all products of biodiversity based enterprises and (b) polluting industries responsible for depletion of biodiversity. A portion of this cess could be used to promote conservation measures within the country. Another portion could be deposited in a Global Biodiversity Conservation Fund which may come to replace the currently functional Global Environment Facility.

The fraction of the national biodiversity conservation cess deposited in the Global Biodiversity Conservation Fund should : (a) increase with the per capita GNP of a country and also (b) increase with the extent of a country's dependence on use of biodiversity resources of origin outside the country. The Global Biodiversity Conservation Fund should be used to support conservation programmes in gene rich developing countries in particular to reward local communities for their continuing participation in conservation efforts.

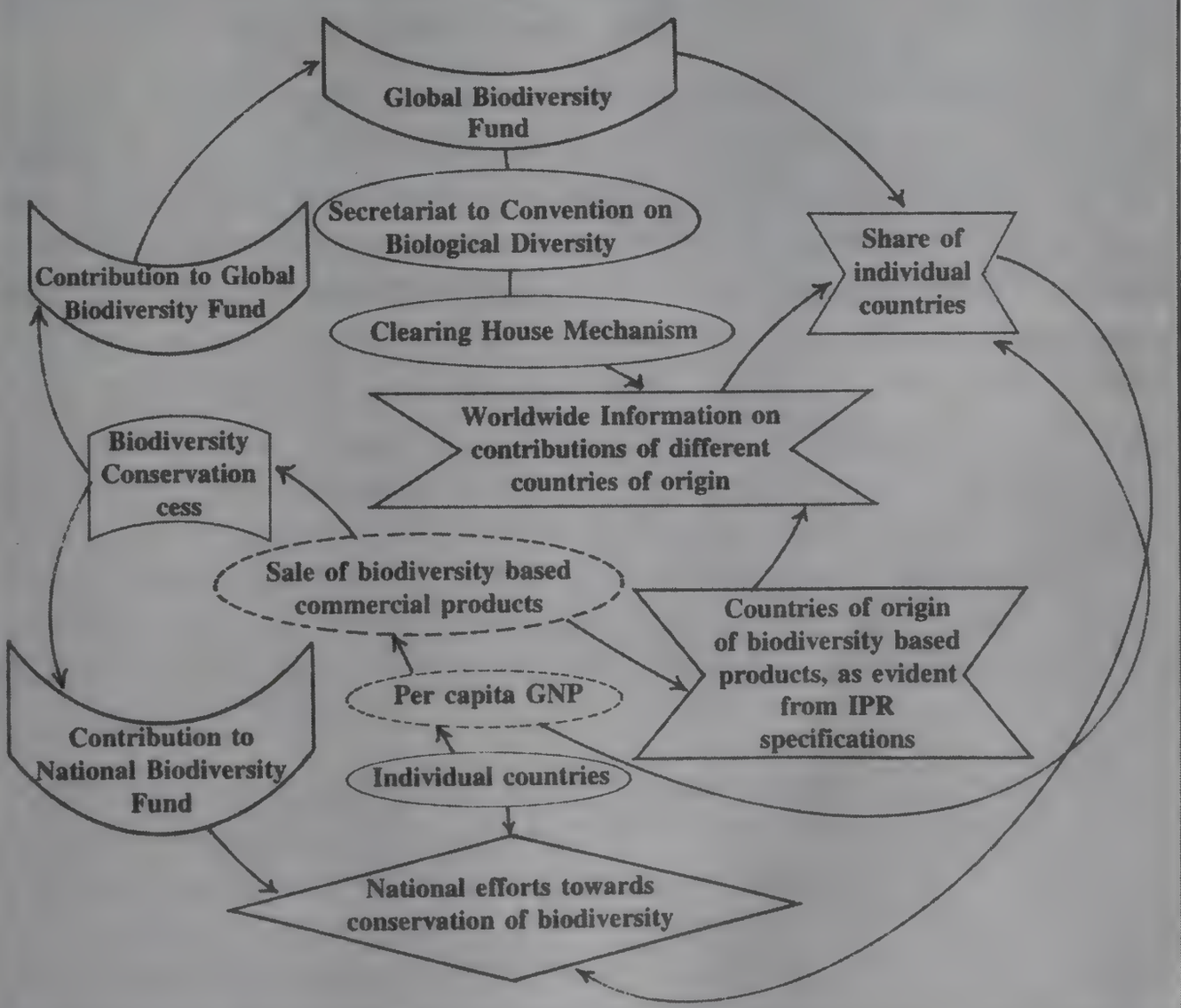
14.3 Country shares

Any country's share in grants from the Global Biodiversity Conservation Fund should be proportional to the extent of use of biodiversity resources for which

it is a country of origin in the patents being worked by biodiversity enterprises throughout the world. This would encourage all countries to promote the use of their genetic resources by biodiversity based enterprises. Industrialized countries may voluntarily forego claiming their share of this fund in the interest of helping the developing world undertake conservation measures more vigorously (Box 16: Financial mechanisms to promote worldwide biodiversity conservation efforts).

Box 16

Financial Mechanisms to Promote Worldwide Biodiversity Conservation Effort


Global Biodiversity Fund
Secretariat to Convention on Biological Diversity
Share of individual countries
Contribution to Global Biodiversity Fund
Clearing House Mechanism
Worldwide Information on contributions of different countries of origin
Biodiversity Conservation cess
Sale of biodiversity based commercial products
Countries of origin of biodiversity based products, as evident from IPR specifications
Per capita GNP
Contribution to National Biodiversity Fund
Individual countries
National efforts towards conservation of biodiversity

According to this proposal, biodiversity based enterprises would have to pay a fixed cess in a given country, based on the volume of their sales, but independent of where and how they have accessed genetic resources, from within the country or outside. The enterprises would then lose nothing by providing correct information regarding the source of the biodiversity resource. This information regarding the source would then determine the fraction of the nationally collected cess deposited by the country in the Global Biodiversity Conservation Fund. This may of course induce Governments to persuade their industries to conceal some information; hopefully this would not be a major problem if the international community succeeds in creating an atmosphere of mutual co-operation. Over and above the cess, the biodiversity based enterprises may be obliged to pay some royalties, but this would depend on specific material or information transfer agreements they may have executed with other parties, a practice that is already prevalent today.

It is vital that India take the lead in developing a set of concrete proposals along these lines, consolidate them in consultation with other developing countries and present them at the appropriate fora. Hopefully we would succeed in carrying them through. But whatever happens in the international fora, we should build up a pragmatic, positive and promotional approach at home.

15
Enhancing Indigenous Capabilities

15.1 Strengths of MNC's

We must accept that this approach has to function in the context of economic liberalization. There is an apprehension that the multinational corporations that are entering our country in the wake of these new economic policies will access our biodiversity resources and then monopolize them with the help of the tightening intellectual property regimes. However, the multinational corporations that are already here, have the strengths which are essential to take full advantage of our genetic resources. For biodiversity resources by themselves are of no commercial value until complemented by an ability to develop a marketable product. This calls for extensive scientific, technological inputs which are currently largely outside the capabilities of Indian industry, laboratories belonging to the Council for Scientific and Industrial Research and our universities and research institutions. On the other hand, the German pharmaceutical giant Hoechst, for instance, is currently engaged in a vigorous programme of screening Indian plants as possible sources of new drugs in their R & D lab in Mumbai; an effort that is more advanced than that of CSIR institutions like the Central Drug Research Institute, Lucknow, or Regional Research Institute, Jammu, or industrial R & D units such as those attached to Ranbaxy or Dabur. Similarly seed companies like Cargill have stronger research and development capabilities in comparison with Indian companies. The Bangalore based company Biocon is very much handicapped by the fact that India does not have a world class facility for deposition and maintenance of microbial cultures.

The role of technological innovations will, if anything, become even more important in the coming years, and while India can and should greatly enhance indigenous capabilities in this direction, at least in the foreseeable future we would continue to lag behind and need co-operation from enterprises from industrially more advanced countries to add value to our biodiversity resources. We find ourselves in this unfortunate situation because of the culture of no

accountability to the industry and to the society at large in which our scientific and technological establishment has been functioning. It is then only rational to accept this ground reality and develop a strategy for enhancing our indigenous scientific and technological capabilities within this global framework.

It is necessary that we accept the broad framework of the intellectual property rights regime prevalent in the industrial countries to function efficiently within this global framework. Of course this regime has been devised by the industrial countries to serve their own interests at the cost of developing countries. But there is an asymmetry in our relationships. The industrial countries can do without access to Indian (though not Chinese) markets; we have not developed any technologies they need. They can even do without formal access to India's biodiversity resources, for many of these are already available to them through *ex situ* collections, others could be accessed with the help of neighbouring countries like Pakistan, Nepal, Bangladesh or Myanmar. So they have begun to impose on us an intellectual property rights regime of their design. We have today no option but to start with this framework and then actively work towards modifying it to serve our interests better.

15.2 Turmeric and neem: Two approaches

The history of developments over patents granted on products relating to neem and turmeric over the last two years well illustrate the merit of the approach outlined above. The point at issue in both cases is the novelty of the application for which a patent is being claimed. Neem has widely been used in India as a pesticide, especially against pests of stored grains for centuries; as has turmeric as an antiseptic against wounds. Granting of patents in the United States for products of these plants towards such traditionally known uses appears quite unfair. The question, of course, is 'in what way is it unfair'? It may be interpreted to be unfair in the broader sense, of all intellectual property rights regimes being considered unfair, or, a little more restrictively, of all patents over biological products being considered unfair. While persuasive arguments may be made for such broader considerations, these arguments have no chance whatsoever of being accepted by the Governments of United States or any other industrial country today. Nor are developing countries in a position to act on such arguments, given the current global reach of GATT. Among those who adhere to these broader objections is Professor M.D. Nanjundaswamy

of the Karnataka Ryot Sangha, a farmers' organization. A group led by him has filed cases in U.S. courts in opposition to neem related patents. These cases have made no headway.

The Council for Scientific and Industrial Research under the leadership of Dr. Ramesh Mashelkar has decided to take the other approach, of accepting the framework of intellectual property rights being enforced through GATT. However, this does not mean that we cannot take any initiatives to try and gradually develop interpretations under that framework in our favour. The CSIR joined the battle accepting the rules of the war, opposed a patent on turmeric and went on to professionally demonstrate to the appropriate U.S. courts that the claims of novelty for the turmeric patent were invalid. This they did by marshalling documented evidence of knowledge of uses of turmeric in India. Unlike the neem case, the turmeric patent has indeed been overturned.

Thus joining the battle with proper professional preparation accepting the rules of the war is only the first step. Our main attempt must be to change the rules of the war. But this can only be attempted if we first gain the experience of fighting the battles successfully on the basis of the existing rules of the war.

15.3 Material transfer agreements

One such modification to the rules of the war was suggested earlier, namely, making it mandatory that all IPR applications, including those for biochemicals and protected plant varieties include specifications of the identity of the biological source materials, information regarding country/ies of origin and an acknowledgment of common public knowledge of related uses. The IPR applications should also include proof that the biological material has been obtained from one of the countries of origin through prior informed consent.

The latter must be based on a material transfer agreement to be registered with and approved by an appropriate agency of the Government of the country of origin. In India this could be the Technology Transfer Division of the Council of Scientific and Industrial Research, which could work in co-ordination with the Ministry of Environment and Forests and the Indian Council of Agricultural Research. We must also try to persuade Governments of countries importing genetic resources to similarly register the Material Transfer Agreements with an appropriate Government agency (Box 17: System of access to informational

and material resources relating to biodiversity). This would provide a basis for the Government of India to pursue proper sharing of benefits such as concessional transfer of technology and location of R & D activities based on such genetic material in India. An appropriate system would also have to be developed for recording transfer of technologies such as for manufacture of biochemicals based on Indian genetic resources in R & D laboratories located in India. For instance, Hoechst may develop a pharmaceutical based on an Indian plant in its R & D facility at Bombay, and then manufacture it in another country using a closely related plant species. It would only be fair that the role of Indian genetic resources be recorded in an appropriate fashion. Such a requirement could be part of the license granted to a company like Hoechst in the first place.

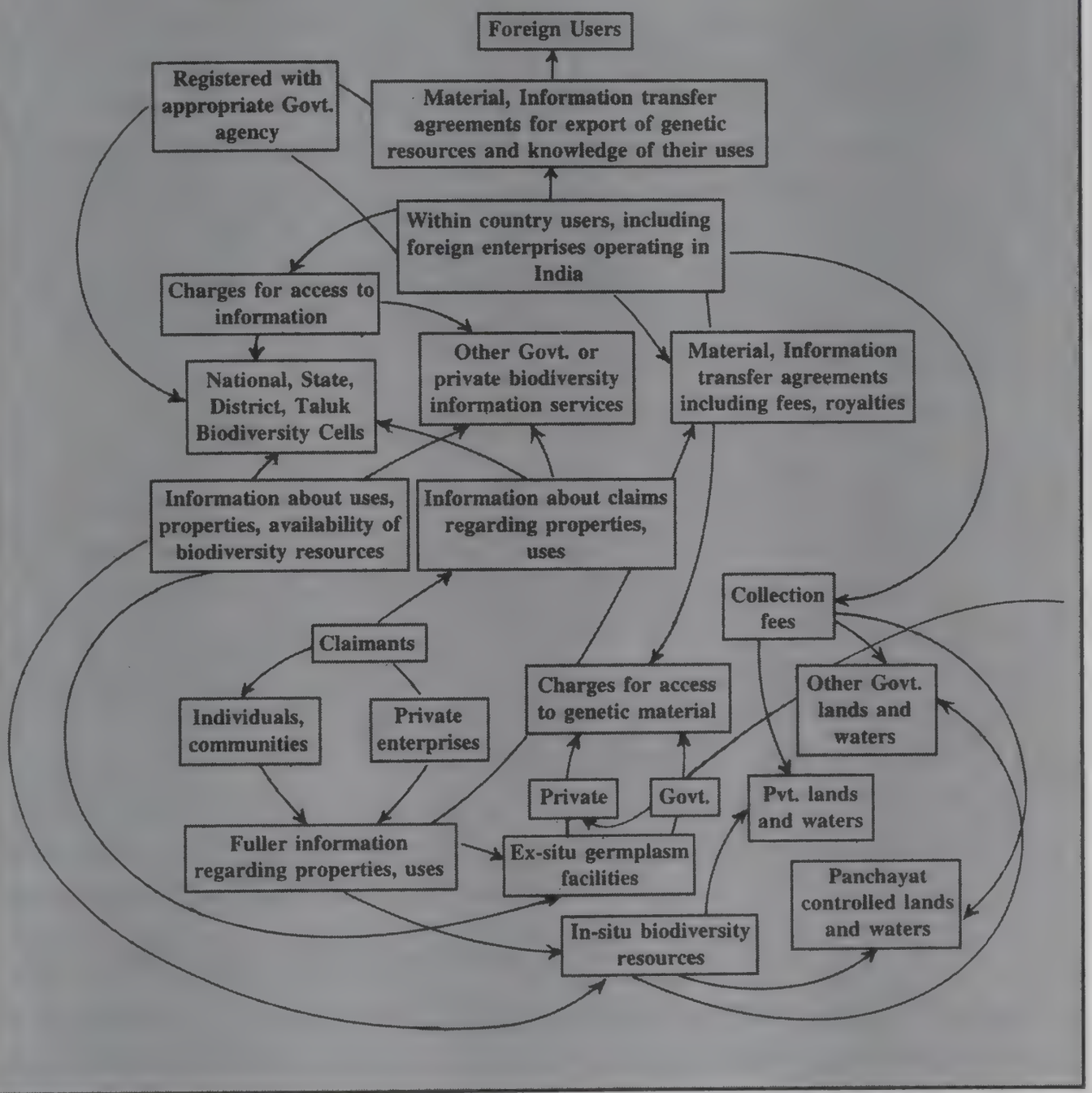
True, India has extensive trade in biological resources, such as basmati rice, or orchid flowers which are not being exported as biodiversity resources. It would be possible to use this route to import material which is then used as a biodiversity resource. The only feasible solution is to require that all importers of Indian biological material certify that it will not be used as a biodiversity resource in the sense defined above, and then permit its export freely as at present.

15.4 Protecting people's rights

Another important area in which India should include innovative provisions in its patent and protected plant varieties legislation is acknowledgment of the contribution of public domain knowledge, and protection of rights of local communities. A basic provision should be the protection of rights of all people to use in perpetuity for a variety of subsistence purposes all plant and animal material naturally produced on their private lands and on common lands and waters. Other kinds of provisions may be appropriate for use of naturally produced living material for certain types of commercial purposes, and of domesticated plants and animals. In future some of the products of natural plants or animals, such as some Ayurvedic drugs may become patented. Similarly cultivated plants may be produced from seeds of protected plant varieties. In these cases Indian laws may protect the rights of individuals to produce the drug for personal use or non-commercial exchange, and the seeds for sowing on one's own land or for across-the-fence exchange.

Box 17

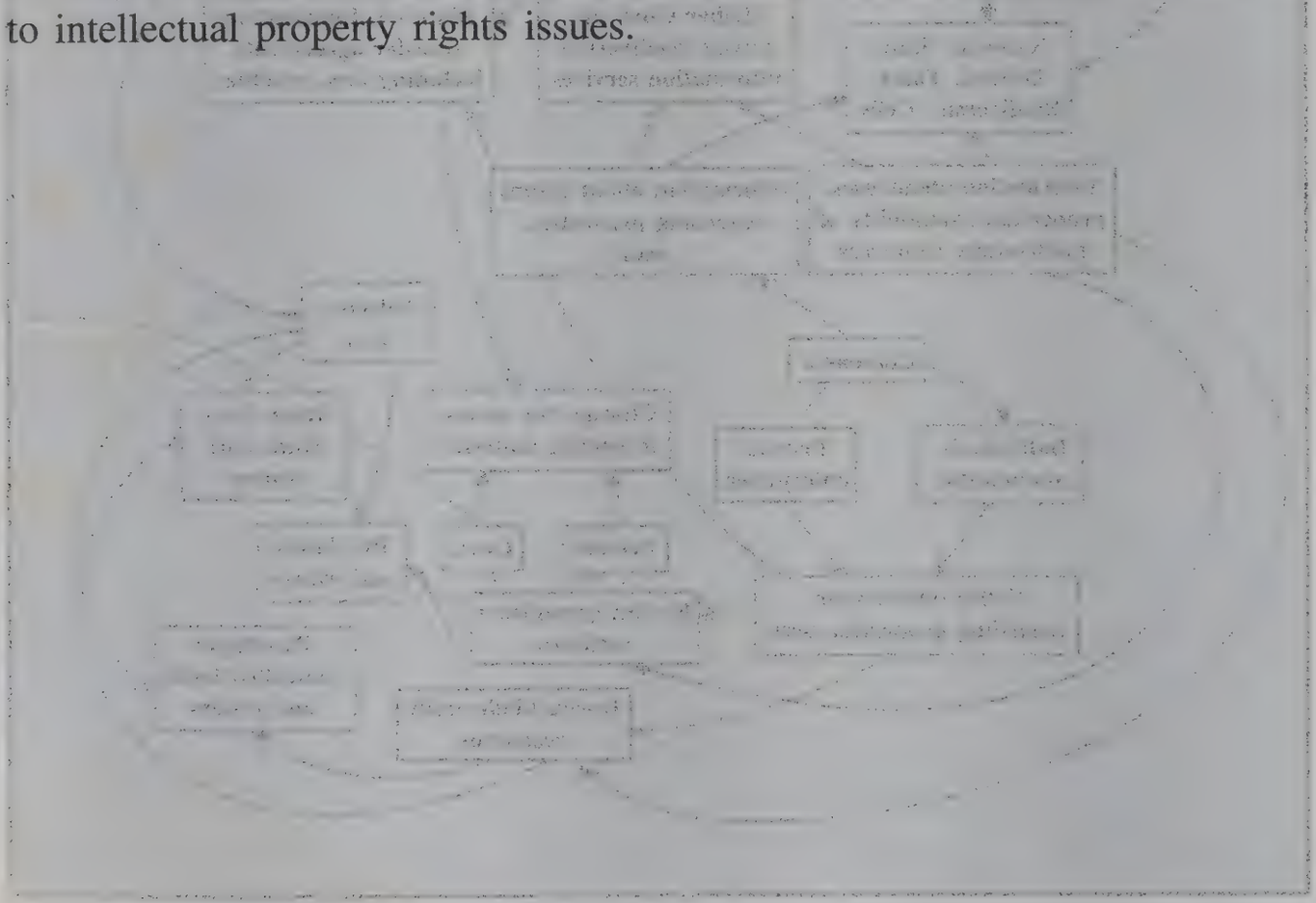
System of Access to Informational and Material Resources Relating to Biodiversity


Foreign Users
Registered with appropriate Govt. agency
Material, Information transfer agreements for export of genetic resources and knowledge of their uses
Within country users, including foreign enterprises operating in India
Charges for access to information
Other Govt. or private biodiversity information services
Material, Information transfer agreements including fees, royalties
National, State, District, Taluk Biodiversity Cells
Information about uses, properties, availability of biodiversity resources
Information about claims regarding properties, uses
Collection fees
Claimants
Charges for access to genetic material
Other Govt. lands and waters
Individuals, communities
Private enterprises
Private
Govt.
Pvt. lands and waters
Fuller information regarding properties, uses
Ex-situ germplasm facilities
Panchayat controlled lands and waters
In-situ biodiversity resources

E 100 N98
11657

15.5 People's biodiversity registers

A much more difficult question is how the intellectual property rights legislation will deal with community based, or public domain knowledge other than broadly acknowledging its existence. Thus an anti-hepatitis drug based on *Phyllanthus niruri* should specify that this plant was widely used in treatment of hepatitis in many different traditional medicinal systems in many countries of Asia. Or a salinity tolerant protected plant variety of rice using a gene from the brackish water, Kagga paddy of coastal Karnataka, should acknowledge that several farming communities were using parental lines for cultivation in saline environments. It is going to be far more contentious to point to particular small groups or individuals as sources of such knowledge. We suggest that this should be based on a country wide system of "People's Biodiversity Registers", that should serve both as a tool for sustainable management of the country's biodiversity resources, and as a source of documentation relevant to intellectual property rights issues.



16
Biodiversity Information Systems

16.1 Multiple forms of information

People's Biodiversity Registers, discussed in greater detail below, should be at the base of an excellent countrywide system of information relating to distribution, status and uses of India's wealth of biodiversity resources. We firmly believe that good information on biodiversity resources of the country, organized and managed through a reliable, financially self-supporting system could catalyze the growth of biodiversity based enterprises for India. Today this information is very incomplete, scattered, unreliable, and pretty much inaccessible though supposedly available largely free of charge. There are several components to this information; as orally transmitted folk knowledge, as claims of uncertain validity, as written text, photographs, videofilms, in scientific publications, in reports for limited circulation, in manuscripts and field diaries, as dead material along with some written information preserved in herbaria, insect collections, other museum collections, as living material in cold storage or as plants being grown on agricultural research stations, in botanical gardens or animals maintained in zoos. New, significant forms of such information include microbes or cells being maintained in cultures, high precision chromatographic patterns of secondary metabolites from plants, DNA fingerprints or nucleotide base sequences. There have been great strides made in automating the management of such materials, and in computerization of such information. The computerized information can now be very rapidly, almost instantaneously, moved around the world with the use of computer networks.

16.2 Organizing a service industry

India is rich in such information and capabilities of handling it—ranging from knowledge of tribal medicine to fingerprinting of DNA—but all this is very poorly organized and largely inaccessible. The root cause of the malaise is that most of it is bureaucratically managed through Government support and made available free of charge. Since the users of the information do not pay, they have no control over suppliers. Since the suppliers do not earn their support

through providing reliable, good quality service, they have no motivation to do so. It is this system which needs to be changed. Production, management and supply of biodiversity related information should be converted into a service industry, efficiently managed and entirely paid for by those using the services. With its inexpensive, large pool of scientific manpower, India could do well in such a knowledge based enterprise. Indeed it could not only attract finances from within India, but through consultancy and research contracts from abroad, as some of the chemical laboratories of the Council of Scientific and Industrial Research, or private companies like Biocon are doing today.

Such an enterprise should be planned as a joint venture involving industry, scientific institutions and the Government, with the latter playing only a catalytic role. The enterprise may, for instance, involve a systematic exploration for soil fungi, their isolation and maintenance in a culture collection, their screening for enzymes of possible commercial interest. Such a programme could be sustained through service contracts, for instance, for maintenance of fungal cultures on behalf of the American Type Culture Collection, or research contracts from foreign companies on specific projects in industrial mycology. Another possibility may be to concentrate on a group of marine organisms, such as Gorgonids, known to be promising sources of pharmaceuticals. A third possibility may be to work on ornamental plants. Bangalore, for instance, is fast becoming a centre of floriculture, but we are currently merely producing roses with Dutch technology for the European market. In fact we have run into trouble already with this narrow approach, with a firm being accused of propagating and selling roses of protected varieties without permission and without paying due royalties.

We must therefore think of taking our own initiatives. We have a wealth of indigenous ornamentals, only a few of which have been properly exploited commercially. Thus Begonias are popular potted plants and we have several species in the wild with genes of possible commercial application that have not been explored at all. Balsams (Genus *Impatiens*) are endemic to Western Ghats and are often cultivated on a small scale in our villages and towns. But there is a great diversity of balsam species with very colourful flowers which could become attractive ornamental plants. An enterprise could be set up in collaboration with seed companies to explore the wild and little explored ornamentals of India, to assess their habitat requirements, to work out propagation

methods, to develop protected varieties and eventually market them on a commercial basis. In all these cases there should be a careful preliminary examination of the commercial potential, possibilities of attracting research contracts and promise of becoming a self-sustaining enterprise. The biodiversity information enterprise should be managed on business principles, unhindered by red tape and on the understanding that there is no long term financial commitment on part of the Government.

A larger and larger proportion of scientific activity in India should thus come to support itself, and to support creation of wealth through enterprise. Science supportive of biodiversity based enterprises is an excellent candidate for beginning such a transition, given India's wealth of biodiversity, and given the provisions of the Convention on Biological Diversity favouring positioning of R & D activities in countries of origin of genetic resources.

16.3 Biodiversity data banks today

Such enterprises must of course be a part of a country-wide extensive network of biodiversity data banks properly linked together through a computer network. The network should help access all manner of information; oral traditions and claims, textual, numerical material, preserved specimens and live material. It should, of course, include information held by national agencies such as Botanical Survey of India, Zoological Survey of India, National Bureaus of Plant, Animal and Fish Genetic Resources, Forest Survey of India, Wildlife Institute of India, National Institute of Oceanography, Central Marine Fishery Resources Institute, Centre for Indigenous Medicinal and Aromatic Plants, Central Drug Research Institute, Institute of Microbial Technology, Institute for Cell and Tissue Cultures. But such information is by and large at a very gross scale, fragmentary and incomplete. The Ministry of Environment and Forests has concluded a countrywide survey of folk uses of plants and animals, but the project has succeeded in tapping only a small fraction of the pertinent information, which is mostly held closely by folk practitioners.

India is a major centre of diversification of mango, one of our important export commodities. Horticultural scientists have done considerable work on mango germplasm, but there is no comprehensive collection, nor any complete data base on thousands of cultivars distributed throughout the country. Mango also occurs extensively in the wild and has supported village level collection

and pickling enterprises. But mango from forest areas has been made available as a raw material to the plywood industry at well below market prices, and in consequence has been rapidly depleted through overexploitation. There is very little information available on the wild strains of mangoes, their abundances and rates of depletion in any pertinent official documents such as Forest Working Plans. Nor is there any good detailed information on a whole range of other wild living resources like medicinal herbs, spices, oil seeds or cosmetics.

16.4 Need for a comprehensive system

Developing a reliable, complete data base to promote effective commercial utilization in conjunction with long term sustainable harvests of India's heritage of biodiversity resources is a major challenge. It is an immense task for valuable elements of biodiversity are not restricted to a few pockets in a few national parks. Rich genetic resources of millets and amaranths, for instance, persist in many remote villages in Western and Eastern Ghats, in the Aravallis and Himalayas. Wild relatives and weedy races of rice occur in broadcast sown paddy fields and small irrigation tanks all over India. Wild relatives of tuber crops like taro and yam flourish along disturbed road verges. Wild edible fruit bearing bushes of *Currissa carandas* and *Ziziphus oenoploea* occur in scrub savannas. As many as 7000 different species of plants are reported to be in use in some tribal system of medicine or other; they are to be found in every kind of habitat on land and freshwaters. It is increasingly felt that coastal and marine animals will be the new storehouses of therapeutic chemicals in the decades to come. These would occur in every conceivable habitat throughout the 200 million hectares of India's Exclusive Economic Zone. We are today unaware of much of this wealth. Local villagers report that the tiny insect-eating plants of genus *Drosera* occurring in rain water puddles on the Western Ghats are quietly collected and exported to Japan. There is no official record whatsoever of such a trade, and no Indian scientist has a clue as to why this plant may be of value. So the task of making a proper inventory of India's biodiversity must truly cover the entire landscape and waterscape of the country, and concern itself with a whole variety of organisms, from tiny leeches whose enzymes preventing clotting of blood are finding application in pharmaceutical industry, to giant mango trees growing along pristine gallery forests.

17
Meeting the Challenge

17.1 Harnessing practical ecological knowledge

The task of preparing an inventory of folk knowledge of properties and uses of this wealth of natural and domesticated biodiversity is equally stupendous. The information of interest will, for instance, include knowledge of use of some vegetable dye that went out of fashion decades ago with the introduction of synthetic dyes, some cultivar of jowar that seems resistant to rust, a tree bark that can be used in washing clothes and a whole range of herbal remedies which may or may not stand rigorous testing. The task is further complicated by the fact that people may not be willing to disclose much of this information, for instance, relating to medicinal uses. We therefore need to devise a system that will encourage people to record their knowledge, with an option to retain part of the knowledge themselves. The information system may then simply record a claim that a certain individual, or community, has an effective remedy against asthma without providing fuller details.

The composition of biological communities, natural and man-made, varies greatly from place to place and from one season to the next. A particular freshwater stream may harbour a fish and snail community very different from another stream a kilometer away. Certain medicinal herbs may be available only for a few weeks a year, and their availability may fluctuate widely depending upon the amount of rains in any given year. The knowledge of properties and uses of the plants and animals is equally uneven, and often full of contradictions. So a comprehensive, reliable system for accessing wild relatives of paddy, or certain medicinal herbs and information relating to their properties and uses will have to be based in a highly decentralized network covering the entire country with continual updating of the information, year by year. A great deal of this information is today available only with the large number of the country's practical ecologists—nomadic shepherds who know which plants are useful in treatment of animal diseases, which plants are poisonous to their sheep and where these plants occur, peasants who know

where there are populations of wild paddy or wild relatives of yams, tribals who know every single mango tree in the forest and the particular flavour of their fruit, or fisherfolk who know every stream harbouring crocodiles. Today this information is not respected, not utilized and is slowly being lost. We can and must establish a symbiotic relationship amongst those trained in modern science and these practical ecologists to create a comprehensive, viable system of biodiversity information covering the country.

17.2 Training barefoot ecologists

To establish such a symbiotic relationship requires that the barefoot ecologists of the country be exposed to the modern scientific system of classification of living organisms, and of the ecosystems of which they form a part. Equally the local health practitioners need to be exposed to elements of the modern scientific system of medicine. Such a training at various levels could with great profit be organized as a component of adult literacy and continuing education programmes in consultation with local school and college biology teachers and other experts from the agriculture, forestry, veterinary and health services. Thus trained, these practical ecologists or local health practitioners would serve as a permanent core support staff for the biodiversity information and management system, for they would be far more rooted than the students, teachers or officials in a given locality.

17.3 Organizing a scientific biodiversity information system

But the formally organized biodiversity information system has to be developed with the support of and within the framework of modern science, and must depend on the participation of large numbers of trained biologists available in every nook and corner of the country. These can only be biology teachers in our High Schools, Junior Colleges and Degree Colleges. An estimated 6000 colleges now cover almost every one of the 5,000 or so taluks or development blocks in the country, employing over 10,000 Master's degree holders in biology. The numbers would exceed 50,000 if we include trained biology high school teachers. Properly organized, this group of biologists will not only generate valuable information to feed the country's biodiversity information system, but the process will also serve as an excellent tool of training in science.

Our present system of science education is not properly geared to take on this challenge. In this system, students of biology have little or no contact with the rich tropical life all around them. Instead they learn some routine facts from books, cut up some dead plants and animals and pass some boring examinations by memorizing such matter. With some additional financial investment, a reorientation of the teaching of biology in the High Schools, Junior Colleges and Degree Colleges could make available an immense amount of human resources to study and document the diversity of life and folk knowledge of their properties, behaviour and uses, in their own villages, taluks and districts. A preliminary experiment along these lines involving some 20 degree colleges along the Western Ghats of Maharashtra, Goa, Karnataka, Tamilnadu and Kerala has demonstrated that this is not only feasible, but could lead to a release of immense pent up enthusiasm amongst biology teachers and students (Box 18: Monitoring India's Lifescape).

17.4 Documentation by student-teacher teams

This would be a bottom-up system of recording information on biological diversity, both wild and domesticated. At its base could be the People's Biodiversity Registers (PBR) prepared by students and teachers of every High School in the country (Box 19: People's Biodiversity Registers). Ideally there should be one PBR per village or independent hamlet, or settlement in the preparation of which one or more High Schools may be involved. The spatial coverage of the activity of each individual High School would depend on the number of High Schools per square kilometer; several in a biodiversity poor city like Mumbai, to perhaps one per hundred or more square kilometers in biodiversity rich states like Mizoram or Arunachal Pradesh. Interacting with local farmers, fisherfolk, shepherds, medicine women, minor forest produce gatherers, mat weavers, these High School student-teacher teams would put together basic documentation on biodiversity resources of local cultivated crops and domesticated animals and natural plant and animal populations, as well as all local trade and processing of biological produce. They would also record local knowledge of properties and uses of biological material and practices of conservation. Though much of this may be difficult to verify, or incomplete, as, for instance, claims of knowledge of certain remedies without disclosing the name of the plant being employed, it would still be worthwhile to record the claims.

Box 18

Project Lifescape

As a megadiversity country, India has a vital stake in conservation and sustainable utilization of its biodiversity resources. This endeavour would have to be grounded in a sound base of information on the distribution and ongoing changes in biodiversity. This calls for a countrywide, continual effort at monitoring biodiversity. With over 120,000 described and an estimated 400,000 undescribed species such monitoring cannot be undertaken on a species-by-species basis. Instead it would have to be attempted as a two-step effort involving: (1) Mapping of ecological habitats throughout the country on the basis of satellite imagery coupled to field verification; (2) Field surveys of a selected subset of species in representative localities. The extensive, regular field work for such a monitoring programme could be most effectively carried out by involving biology students and teachers in the 6000 odd science colleges distributed throughout the country. They will, of course, have to be helped and guided by more sophisticated technical agencies such as Botanical and Zoological Surveys and University departments. Such a programme needs to be supported in terms of hardware (e.g. descriptions of selected subset of species, of ecological habitats and standardized survey methods), and software (e.g. syllabi incorporating ecological field work as practical exercises, data bases for organizing the information generated) followed by field trials in colleges. The effort would create a broad base of taxonomic and ecological capability essential to promote prudent management of India's heritage of living diversity. The Indian Academy of Science has launched a project named Lifescape on the occasion of the birth centenary of Dr. Salim Ali to help prepare the required hardware and software and to promote appropriate field trials.

The methodology of the project involves the following steps: (i) Development of a network of experts, (ii) Obtaining inputs from the experts to prioritize and identify target taxa and appropriate survey methods, (iii) Commissioning illustrated accounts of target taxa, keys

to their identification and of survey methods, (iv) Organising reviews of the material from perspectives of scientific accuracy as well as accessibility to users, (v) Field testing of the material generated on a pilot scale, (vi) Final production of the material employing print, OHP and electronic media.

(i) Organization of a network of experts

This participatory project depends upon the collaboration of a broad base of experts knowledgeable about different taxonomic groups, different habitats and sampling methods. A beginning has already been made in organising a network of such experts through an invitation published in a number of periodicals. Those responding to the invitation have been requested to provide details of their expertise and the responses computerized. By January 1998, the Indian Academy of Sciences had received 1302 simple responses and 258 questionnaires providing details of their expertise. The project has organized a small core group of experts into an Editorial Board, and a group of more senior experts into a National Advisory Board.

(ii) Identification of target taxa and appropriate survey methods.

Several discussion meetings, as well as correspondence with the experts have focussed on developing criteria for and working out the set of target taxa for monitoring. Possible candidates for selection of target taxa include:

Economic significance: e.g. medicinal plants, wild food plants, plants producing minor forest products such as tendu leaves, genetic resources such as wild relatives of cultivated plants or domesticated animals, animals which may be bred under domestication with profit, such as in butterfly farming, crop pests, weeds, crop pollinators, vectors of human diseases, fresh water fishes.

Striking appearance and therefore ease of and attraction to observation: larger mammals, commoner species of birds, crocodiles, fireflies, dragonflies, plants with attractive flowers, large trees.

Cultural significance: Monkeys, peafowl, Ficus species such as peepal.

Conservation significance: e.g. endemic or threatened species.

Desirability of having representatives available in all parts of the country, from Port Blair in Andamans to Leh in Ladakh, and from rainforests of Mizoram to concrete jungles of Mumbai.

Desirability of having representation of all groups of living organisms. Thus we should include seaweeds, lichens, mushrooms, ferns along with higher plants amongst wild food plants.

A number of experts have responded by suggesting specific target taxa by filling out a prioritization sheet which scores the suggested target taxa in terms of a series of criteria. Based on these inputs, we have arrived at an initial list of about 1400 broader taxa as follows:

Objectives	**No. of species or higher taxa**
Intrinsic value	Mammals 40, Birds 200, Reptiles 25, Amphibians 15 Butterflies 50, Orchids/Epiphytes 25, Trees 65
Potential genetic resources	*General :* Trees 15, Herbs 30, Shrubs 20, Climbers 25 *NTFP* Bamboos and Rattans15, Other trees 15 Non-medicinal herbs 2
Ecosystem services	*Pollinators:* Bees (Genera) 25, Wasps 25, *Predators:* Spiders 15, Mantids 20,

Keystone resources	Figs 15, Termites 25
Sustainable use	Medicinal plants 250, Freshwater fishes 100
To promote ecologically sound methods of control	Pests of rice/coconut/arecanut 75 40-50 fungal and bacterial diseases, Weeds 50, Vectors of human and livestock diseases 15
As indicators of soil quality	Earthworms 10, Mushrooms 20, Soil arthropods 10 (Millipedes, Collembola), Termites 5
As indicators of water quality	Aquatic insects (Families) 50, Freshwater molluscs 20, Aquatic weeds and plants 15
As indicators of air quality	Lichens (Group) 3, Thalloid liverworts (group) 1
To represent evolutionary lineages not covered above	Myxobacteria 20, Planarians/Rotifers 10

(iii) Commissioning illustrated accounts of target taxa, keys and survey methods

These accounts would be commissioned from concerned experts based on broad guidelines. The taxonomic accounts would be aimed at permitting biology teachers and students, without special expertise in any particular group, to identify the concerned organisms upto some level of taxonomic hierarchy, with a high degree of reliability. The taxonomic hierarchy to which such identification would be attempted would vary with the concerned organism. Thus a particular bird species such as black drongo *(Dicrurus adsimilis)* would be identified down to species level, while another related species, bronze

drongo *(Dicrurus aeneus)* would only be identified as belonging to the family Dicruridae, since the particular species, liable to be confused with related species of black and grey drongo would not be included amongst the focal set of taxa at the species level. In case of insects, the attempt would be to identify only a few species, such as the butterfly *Papilio polymnestor* or *Troides minos* down to species level; others may be identified only as belonging to order Lepidoptera.

The material prepared would be geared to help reliable identification down to an appropriate level thus decided upon. The material would include keys —with good illustrations—to help in such identification. The descriptions would include field characters, geographical distribution, habitat preference, behaviour and habits, and hints for discrimination from related taxa. The descriptions would include known names in Indian languages and discussions of human significance, including mention of the organisms in literature, in arts. They would suggest appropriate methods of population assessment which would be spelt out in detail in the manual on survey methods. The descriptions would also include suggestions for interesting projects for students.

The accompanying manual on survey methods would focus on methods that can be applied widely by college teachers and students without calling for any sophisticated equipment or extensive computations.

(iv) Reviewing the Material

The accounts so prepared will be peer reviewed by technical as well as communications experts. The accounts would then be recast to fulfill the purpose of the programme.

(v) Field testing the material

This material will be field tested through a network of college groups working in different parts of the country.

(vi) Final Products

A series of final products are visualized. These include (a) loose leaf binders, with a college group ordering accounts of only those taxa pertinent to their own study locality and interest, (b) bound books, such as a field guide to freshwater fishes, (c) overhead projector transparencies for classroom use, (d) floppies and CD ROMS, (e) home page on World Wide Web.

Box 19

People's Biodiversity Registers

Objectives

PBR is a programme of organizing information available in the domain of folk science on the status, uses and management of living resources. This is information with practical ecologists, people who deal with living resources as a part of their daily subsistence activities as graziers, as fisherfolk, as basket weavers. It is information with simple folk, who are nevertheless specialists of slow science, such as tribal medicinemen, or expert honey gatherers. The information is almost exclusively orally transmitted. It may often be guarded as secret, as certain herbal remedies are or may be very widely known—as the use of turmeric as an antiseptic is—all over India. This information may be documented in PBRs in full, or as claims that only partially reveal the information. In the longer run, the PBRs would attempt to collate, verify, synthesize and make this body of information available to the society at large, as well as feed it back to the village communities.

The objectives of the programme thus embrace the creation of decentralized countrywide databases on:

a) Status of biodiversity resources such as localities and levels of populations of medicinal plants, cultivars of fruit trees or freshwater fishes.

b) Various factors such as harvests and trade from natural populations, changes in agricultural practices or discharge of industrial effluents, affecting the biodiversity resources.

c) Ongoing involvement of local communities/ individuals in sustainable use and conservation of biodiversity resources, such as systems of regulated grazing on pastures, maintenance of varieties of fruit plants like jackfruit on farm bunds or protection of fish in sacred ponds.

d) Local knowledge, widely shared and publicly disclosed, of properties and uses of biodiversity resources e.g. drought-resistance of a certain cultivar, methods of preservation of food or use of certain plants in treating human or livestock diseases or market prices of non timber forest produce.

e) Local knowledge only partially disclosed; for instance, a claim that a particular medicine woman knows of a cure for asthma.

f) Perceptions of local people on participatory management options for conservation, sustainable use and equitable sharing of benefits relating to biodiversity.

In the long run, the programme would also attempt to:

g) Validate the information thus recorded; for instance, through crosschecking with other published information sources.

h) Create a network of decentralized databases, ultimately linking them to a consolidated national data base which would give full credit to the origin of information at the level of an individual, a community or a village council.

i) Feed pertinent information, such as volume of trade and prices of medicinal plants back to the local communities.

j) Contribute to countrywide monitoring of biodiversity resources, conservation efficacy and management options.

End uses

It is hoped that the creation of such a countrywide decentralized yet networked system of information of slow science stream will serve several important purposes. It will, for the first time, create a machinery for monitoring the fate of a variety of biodiversity resources, be it medicinal plants, land-races of crops, breeds of livestock, or wild relatives of cultivated plants throughout the country. Such information could then form the basis of locally rooted, adaptive strategies for the conservation of these resources. Such an information system giving full and proper credit to informants would serve to give recognition and encouragement to the practical ecologists everywhere, many of whom are formally uneducated, yet have a deep fund of knowledge about the living world and its human uses. This could also be eventually linked to a system of properly recording and establishing connections amongst the many different strands of more formal systems of slow science, such as the Ayurvedic traditions of Kerala and Western Himalayas or the Siddha medicine of Tamil Nadu and the Tibetan medicine of Sikkim.

Such an information system is also essential to begin a process of drawing on a part of the commercial profits made from further development of this broad base of slow science; an obligation India has accepted as a party to the Convention on Biological Diversity. There could be several ways of tapping such profits. Biodiversity-based enterprises may be charged some fees for accessing these information bases. They may pay a cess on their sales. Such income may be deposited into a National Biodiversity Fund which may be used to reward individuals, communities or village councils for their contributions towards:

a) Ongoing conservation of biodiversity resources on their private lands/waters or on public lands/ waters within their jurisdiction.

b) Recording of practical ecological knowledge.

c) Recording of more systematized slow science, such as locally available manuscripts on the Siddha system of medicine.

Additionally, the information system could help individual entrepreneurs establish contacts with claimants who do not fully disclose their knowledge. The two may then negotiate and decide on equitable sharing of benefits of possible commercial exploitation of such knowledge by entering into an appropriate Information or Material Transfer Agreement.

Methodology

The People's Biodiversity Register programme was initiated by the Foundation for Revitalization of Local Health Traditions (FRLHT) as a programme focused on documenting community based knowledge of medicinal plants and their uses through a workshop held at the Indian Institute of Science, Bangalore in April 1995. Workers from voluntary agencies participating in this workshop went on to compile by mid-1996 what were termed as Community Biodiversity Registers at 24 sites distributed over 10 states of the country. This experience suggested that it would be desirable to broaden the scope of the exercise to all elements of biodiversity, as also to record knowledge and perceptions at all levels from individuals, households, ethnic groups to multi-ethnic communities. The name of the programme was therefore modified to People's (in place of Community) Biodiversity Register. A second workshop to explore this broader approach was organized at Supegaon in Maharashtra in August 1995. This was followed by initiation of PBR activities at 10 sites in 4 states of the Western Ghats region as a part of the Western Ghats Biodiversity Network (WGBN) Programme. These experiences laid the foundation for the preparation of PBRs at 56 sites in 7 states as a part of the Biodiversity Conservation Prioritization Programme (BCPP) of the World Wide Fund for Nature (India).

The BCPP-PBR programme was initiated through a workshop held at the Indian Institute of Science, Bangalore in March 1996 involving potential collaborators from the states of Himachal Pradesh, Rajasthan, Bihar, Assam, Orissa, Karnataka and the Union Territory of Andaman and Nicobar islands. These 7 regions have been selected so as to provide

a good sample of the varied ecological and social regimes of the subcontinent. The discussions at this workshop permitted a crystallization of the methodology and drafting of a methodology manual termed Srishtigyan (Hindi : Srishti - nature, Gyan - knowledge). There followed a series of further training programmes and workshops that have facilitated the field work spread over 56 sites throughout the subcontinent employing a common methodology.

The first task of the state level co-ordinators was to select the individual study sites. These were so selected as to represent the entire spectrum of ecological and social regimes within the state. This was followed by appropriate choice of field investigators from amongst college or University level science teachers or workers of rural development or environment oriented NGO's. Many of these belong to localities from or close to study sites, with considerable previous familiarity with the study sites. The field investigating teams worked closely with, and often included some of the local residents.

The methodology of field investigations included the following components: building of rapport with local people, identification of different user groups, identification of individuals knowledgeable in different aspects of distribution and uses of biodiversity, individual as well as group interviews with members representing different user groups as also knowledgeable individuals, mapping of the landscape of the study site, field visits to representative elements of this landscape along with some local community members and knowledgeable individuals, discussions with the entire village assembly, discussions with outsiders affecting the resource use at the study site such as nomadic shepherds or artisans, traders and government officials.

Preliminary results

User groups

India harbours one of the most complex and diverse of human societies made up of about 40,000 to 60,000 endogamous groups. These

endogamous groups traditionally pursued rather narrowly circumscribed modes of earning livelihoods; these livelihood strategies were vertically transmitted from generation to generation in a fairly conservative fashion. The relationship of Indian people whether it be in tribal hamlets, in camps of nomadic communities, in villages or in towns, to the biodiversity resources is therefore strongly dependent upon the number and identity of the endogamous groups present and their traditional strategies of earning livelihoods. This is not to say that these livelihood strategies have not changed over time, especially in recent decades, but that the currently adapted livelihood strategies are still strongly conditioned by the traditional ones.

The first step in the preparation of PBRs involves documenting the composition of the human population in the study site, which may be a single hamlet, a large village, a town or part of a city. At one extreme, in a tribal hamlet the livelihood strategies may be broad based and homogeneous, with all households being involved in gathering plant material, fishing and hunting for subsistence use, in maintaining some livestock such as chicken or fish for household consumption, in practicing shifting cultivation for production of grain for household consumption, in weaving baskets, or mats, again for household consumption, and in harvesting rattan for marketing. At the other extreme in a large village close to a market town the livelihood strategies may be more specialized with much greater diversity amongst different households. Thus such a village may harbour specialist fisherfolk who fish primarily for the market, while many others fish occasionally for household consumption. It may include many landless farm workers who gather, hunt and fish for subsistence, and weave mats and baskets for the market. It may include artisans who specialize in making cane furniture for sale, and others who only make decorative articles from wood. It may include traders who specialize in timber or medicinal herbs. It may include barbers or washermen who reside in the village and provide services to the local population, with little direct dealing with living resources; or outsiders who may be employed

as forest guards and are involved in regulating harvests of forest produce.

The focus of the PBR exercise is on documenting the composition of the human population, both resident, nomadic and occasional as user groups, the user groups being defined from the perspective of their relationship with biological resources. The diversity of such user groups is low in areas rich in biological diversity, insulated to some degree from the market influences. This diversity is also low in more highly urbanized areas, dominated by people involved in occupations in the industrial and services sectors. It is highest in localities highly dependent on natural as well as husbanded biological resources, but with strong market linkages.

In recent decades, the composition of communities in terms of user groups has been greatly influenced by transport and communication leading to increased frequency of visits by outsiders, as well as more permanent migrations. Thus streams earlier fished only by local fisherfolk may now be exploited, including by novel techniques such as dynamiting, by outside fisherfolk or by armymen. Similarly there has been extensive encroachment on village community woodlots in Karnataka Western Ghats by immigrant horticulturists from Kerala. There has also been increasing assertion of control over community woodlots by state forest departments with the coming in of forest guards and other officials.

Such developments have meant a weakening of control by well defined local groups of people over local biological resources. This in turn has meant a lowering of interest of the local people in use and sustainable management of biological resources almost everywhere in the country and consequent erosion of practical ecological knowledge and wisdom.

Landscape

The second step in the preparation of the PBRs involves mapping and description of the relevant landscape. The limits of this landscape may

best be defined with reference to the area from which the focal human population meets the bulk of its manifold requirements of biological resources, not through purchase, but gathered, cultivated or husbanded by their own efforts. Resources so acquired by their own physical effort may include wild fruit or fish, fuelwood, fodder for their livestock, leaf manure, rattan or bamboo, medicinal herbs. These may be consumed at home, or sold on the market. The area from which such resources are brought may vary a great deal; thus some particular medicinal herbs may be brought from a much greater distance than the fuelwood or fodder. There may also be considerable variation in the sizes of their resource catchments amongst different households. Thus a large landholder may meet all the requirements for biological resources from personal landholdings, either as a primary product, or as a by-product of agriculture or animal husbandry, while a landless household may range over a wide area to collect fuelwood for domestic consumption, or bamboo for weaving baskets for the market.

The landscape of interest thus has to be defined carefully in relation to the different user groups most heavily dependent on the gathering of natural resources and therefore on a relatively more extensive area. It is also important to note the often extensive overlap in the resource catchments of neighbouring human settlements, overlap which has significant implications in terms of involvement of the local people in the management of these resources. Thus defined, the landscapes are invariably larger in size, of the order of 200-300 km^2, and cut across limits of lands administratively assigned to particular villages.

In every one of the study locales, the landscapes are highly humanized with many managed (e.g. paddy fields) or semi-natural (e.g. village woodlots) elements interspersed with fragments of forests or streams often stripped of riparian vegetation or driftwood. The boundaries of individual landscape elements have been increasingly defined more sharply, with shifting cultivation being replaced by settled farming, or forest patches being brought under state control as reserved or revenue

forests. The nature of particular landscape studied varies a great deal based on topography, climate and history of human use. Thus the landscapes are rather simple, largely made up of dryland farms and grazing lands barren of woody vegetation in the semi-arid tracts of peninsular India; they are much more complex, sheltering a diversity of elements ranging from original forest vegetation protected as a sacred forest, and moderately exploited reserved forest, to rubber plantations, betelnut orchards and paddy fields in the humid, hilly tracts of the Western Ghats.

Local people have their own understanding of the landscape with terms for broad landscape element types, such as close canopy forest, or paddy fields, as well as specific names for particular patches of forest or particular fields. The PBR exercise involves mapping of the landscape, both in terms of vegetation cover with use of appropriate terms of landscape ecology, and mapping as an overlay in terms of the understanding and naming of the landscape by local people. Such maps are an important tool in understanding the patterns of use and management of the different landscape elements by local people as well as outside actors. They form the basis on which local communities spell out their own strategies for conservation and sustainable use of biological resources.

History

The third step in the preparation of the PBRs is a recording of the history of the user groups, the landscape and the biological resources of the study site. Of particular significance in this context is the history of the regulations governing the access that the various local people as well as outsiders have to different elements of the landscape and biological resources. Such history is obviously very important to an understanding of the current status, currently prevalent use patterns, and management options for the future.

There are several rather consistent and widespread patterns in the histories recorded in our study sites. In terms of changing regimes of access, they are dominated by derecognition of control by communities

and assertion of control, either by the state or by private parties. In pre-British India, the local communities exerted substantial de facto control over local land, water, biological resources. The British land settlements led to substitution of this control by private ownership of cultivated lands and state control over all other lands such as forest or grazing lands, and waters, especially streams, rivers and coastal areas. These trends were further reinforced after independence as the bureaucracy grew in size and powers. There has however been a limited reversal of these trends in recent decades with involvement of communities in programmes of co-management such as Joint Forest Protection and Management. This has catalyzed the spontaneous growth of self-organized village forest committees as well, including at some of our study sites in the state of Orissa.

Other widespread trends include a continuing growth of manmade structures such as buildings, roads, wells and canals, a replacement of the subsistence oriented cropping pattern by one geared towards production of cash crops, and a degradation of natural vegetation on public lands compensated in part by the raising of tree plantations. The dominant response to overuse and degradation of natural vegetation and animal life has been a strengthening of state sponsored conservation measures. Such measures have also tended to alienate local communities from access to the natural resources of state owned lands. Local communities have often tended to react to such alienation by illegally indulging in overexploitation. Thus in the Karnataka Western Ghats district of Chikmagalur, the overuse of natural evergreen forest, primarily to supply raw material to plywood industries led to the creation of Kudremukh National Park. As soon as the area was declared a national park, local people from our study site at Kigga went on a spree, felling trees to stock timber in their houses to guard against anticipated difficulties in accessing the vegetation within the boundaries of the National Park.

Knowledge base

The knowledge with local people of the landscape, the biological resources and of how these are managed is basically practical knowledge, knowledge

of relevance in dealing with the environment in their day to day pursuit of acquiring a livelihood. They have labels—or names—for landscape elements that have different uses and levels of access. These extend over their own resource catchments; they also have some familiarity with the market towns and cities, but little knowledge of other parts of the countryside. Similarly they are familiar with a few hundred different kinds of living organisms which either have a variety of uses, are a nuisance or are dangerous or poisonous to themselves or their livestock. Some of this knowledge is very widespread, for instance, the use of leaves of neem trees for their insect repellent properties in the storage of food grains is prevalent over most of India; such a use has been recorded in a variety of texts on uses of plants; it has also been validated through modern scientific research. At the other extreme, is knowledge of uses such as a particular treatment of snake bite which may be confined to a single person in a particular village. That person may traditionally keep such knowledge to himself and may only pass it on to another person when at an advanced age, again on the understanding that it will not be widely shared. Such knowledge may or may not be validated empirically if subjected to further scientific scrutiny. Our PBRs do not for the present, attempt to probe and record details of such alleged knowledge; in their place we only record the broad claims of existence of such knowledge.

The PBRs suggest that the largely practical ecological knowledge is shared to varying extents across geographical distance, as well as amongst different social groups. The extent to which it is shared or monopolized also varies a great deal. There is however a very widespread tendency, that of loss of this, largely orally transmitted practical knowledge as the people lose their dependence on and access to local natural resources, and as the younger generation loses its roots in the locality and more traditional ways of life. This has some interesting consequences. The knowledge of herbal medicines is generally transmitted by the specialist medicinemen to one or more of their sons. But in the village Neralekkoppa in Chikmagalur district this knowledge now resides with

and is practised by two ladies who acquired it from their father. The father passed this knowledge on to his daughters because none of his sons were interested in acquiring it and in practising traditional herbal medicine.

Such knowledge has been gradually acquired and codified over centuries in more formalized Indian systems of medicine such as Ayurveda. Interest in such codification prompted the preparation of one of the earliest of modern botanical treaties, the Hortus Malabaricus by Van Rheede between 1678 and 1693. It gathered further pace during British reign beginning with Colonel Watt's Wealth of India series. This process continues today at the behest of many transnational pharmaceutical corporations. In fact, a local medicineman, Kunjeera Moolya is thus currently engaged by a pharmaceutical company in recording his knowledge of medicinal uses of plants at one of our study sites, village Mala in Karnataka State.

Bioresources

The fifth module of PBR is an inventory of the current occurrence and history of biological resources as recounted by people for the different elements of the study landscape. Such an account is of considerable potential value in developing a conservation programme for resources such as medicinal plants. There is extensive use and large scale domestic trade as well as export of natural populations of medicinal plants in India. However almost all of this is in the informal sector; while there is abundant anecdotal evidence of the steady decline in the population of most species thus used, there is no documentation of their status. The most detailed information in this context is available with people involved in the collection of medicinal plants in their own localities. PBRs record a sample of such information; and could potentially provide an excellent tool for monitoring the sustainability of use of medicinal plant resources of the country. They could serve such a purpose for other resources such as freshwater fishes as well. At the same time they could be a tool for monitoring the countrywide changes in populations of weed and pest species.

Economic utilization

India has a biomass based civilization with a large fraction of the country's tribal and rural population dependent on biomass either gathered through their own labour or produced through low input agriculture or animal husbandry for fulfillment of many of their subsistence needs such as wood or cowdung cakes as fuel for cooking meals, or bamboo and small timber for construction of houses and cattle sheds. This dependence on biological resources for subsistence continues; although people are now in considerable difficulties in many parts of the country because of reduced availability of these resources. At the same time there is a very substantial increase in people's involvement in marketing of biological resources such as medicinal plants for cash incomes. There has been a parallel transition in agriculture as well, with subsistence cultivation giving way to production of cash crops. In an analogous fashion, fishing from freshwaters largely for local consumption is giving way to aquaculture for distant markets as well as for export abroad.

There are a number of elements of non-sustainable use of resources, and uses of resources which bring very low returns to local people in the course of this transition to a market economy. This is little documented; the PBRs provide an excellent tool for this purpose. The PBRs also bring out the many social and economic forces driving these processes. They document that local people working as collectors of such biological produce have hardly any knowledge of the eventual destination of the material, the end uses, and market prices. As far as the local people are concerned, the demand for such products is also highly fluctuating and unpredictable. Furthermore, most of the collectors are very poor and often in perpetual debt. They are unorganized, and generally not in a position to control and properly run co-operative societies such as Forest Labourers Co-operatives even where they have been set up. As a result, a very widespread trend documented by the PBRs is involvement of local people in collection of such biological material at very low levels of earning, set by the daily wages being paid for agricultural labour. Their

tendency is therefore to collect as much as possible without any concern for long term sustainability of the supplies. This is further exacerbated by possibilities for outsiders to move into the region and violate any traditional norms of prudent harvests, such as taboo against poisoning or dynamiting of rivers. The current regime of commercial harvesting of these biological resources is therefore entirely unfavourable to sustainable use, or to benefits flowing to local people. The PBR exercise has, in our experience, served the useful purpose of making local people aware of the situation and stimulating their interest in the possibilities of more sustainable harvests coupled with better returns, including local level value addition, to the local communities.

Conservation measures

The seventh module of PBRs documents conservation measures, their implementation and their implications from the perspective of the local people. Such conservation measures include traditional protection to sacred sites such as sacred ponds or groves, or to sacred species such as hanuman langur or the peepal tree. They also include modern state sponsored conservation measures such as wildlife sanctuaries and national parks. Some of the traditional conservation measures are widely subscribed to and even now quite effective, such as the protection of several species of monkeys or fig trees of the genus Ficus on religious grounds. These are documented from a large number of our study sites. Others are widespread, but now in decline. These include protection to or highly regulated harvests from sacred groves. Interestingly enough, some of these are showing signs of revival following decline. Thus local people have newly established a sacred grove in the village Shyampura in Rajasthan in response to acute degradation of natural woody vegetation. Other conservation practices are more local, yet effective in some places. These include protection to the multipurpose tree *Prosopis cinerarea,* to antelopes, chinkara, nilgai and blackbuck and to the peafowl in villages of people subscribing to the Bishnoi sect.

Other conservation oriented practices not based in religious beliefs but in social conventions such as regulated grazing in village pastures also exist, although these too have weakened with loss of local control over land and water resources. Nevertheless, such practices are newly emerging in some areas in response to resource exhaustion. Notable examples documented in PBRs from our study sites include community based forest protection systems spontaneously established by local people in several villages in the state of Orissa.

The PBRs also record the perceptions of local people in relation to state sponsored conservation programmes such as National Parks. As recorded, these seem uniformly negative. The local people see these programmes as geared towards denying them traditional access to the resources of protected areas. They contend that this sets people against such state sponsored conservation measures with which they do not co-operate. At the same time they perceive the bureaucracy as being inefficient, and often corrupt and unable to control overexploitation of protected areas by commercial interests. A notable example is that of Bharatpur National Park, an important wetland for waterfowl. Severe restrictions on grazing by buffaloes maintained by local people have resulted in the excessive growth of a grass, Paspalum, choking the water bodies and rendering them less attractive for water birds. The local people also contend that keeping them out has opened the associated woodlands to greater levels of illegal tree felling by outsiders.

Development aspirations

The eighth module of PBRs documents the development aspirations—both at personal and community level—through individual as well as group discussions. These are aimed at arriving at an understanding of how people's aspirations could be related to possibilities for conservation and sustainable use of biological resources.

Some universal trends are evident. As noted above in the section on economic utilization, the current systems of management do not promote sustainable uses of biological resources, they also bring minimal economic

returns to local people. Furthermore, as noted in the section on conservation measures, people have a negative view of state sponsored conservation programmes. As a result, conservation and sustainable use of biodiversity resources are not concerns that have any significant appeal to the masses.

On the contrary what people see today is that while poverty is endemic to biodiversity rich areas, prosperity resides in areas rich in man-made rather than natural capital, such as in Mumbai, India's commercial capital. The development aspirations of the people are therefore focused on persuading the state to create more man-made capital for them, capital in the form of roads, bridges, irrigation facilities, drinking water facilities, hospitals, schools and colleges.

The PBR exercise has thus brought out very clearly the need for major reorientation of the current system of management of biological resources if their conservation and sustainable use are to become part of the priorities of people at the grassroots.

Conflicts and Consensus

Natural resources in the public domain are particularly susceptible to the tragedy of the commons - to the inability of the people to join hands to behave in a disciplined fashion towards common good. The various actual and potential conflicts amongst different households or user groups in the management of biological resources are therefore very significant in working out regimes of conservation and sustainable use. The ninth module of the PBRs therefore documents such conflicts, as well as areas of agreement.

The conflicts are primarily rooted in different levels of access to natural as well as man-made resources and to the political and administrative authority amongst different user groups. Thus in village Neralekoppa in Chikmagalur district the small holders extensively engaged in collection of forest produce have an interest in organizing themselves to regulate harvests and get better returns, while the politically more influential trader has diametrically opposite interests. Similarly, in most

study sites the local people would like more authority over the management of local forest resources, while Forest Department officials would prefer to retain all authority themselves. All PBRs have many examples of such conflicts, often dependent on conditions specific to each locality.

Management Options

The tenth module of PBRs specifically poses the question of priorities that local people accord to conservation of different elements of the landscape and to the different species of plants and animals, and the strategies people advocate to achieve conservation and sustainable use of local biological resources. As noted above, today these are not issues that merit high priority in the people's view. As a result, it requires considerable effort, including suggestion of a number of alternative possibilities by the investigators to elicit any responses. However, all investigators were successful in persuading people to spell out their preferences.

There are three trends that are common across most of the PBRs. Utility is the dominant consideration in people's assignment of conservation priorities for landscape elements as well as species. It is however not the only element; people also consider cultural traditions such as protection of monkeys or fig trees or of sacred ponds in assigning conservation priorities. It is therefore to be expected that people's preferred management strategies focus on creating conditions under which local communities can derive substantial economic benefits from sustainable utilization of biological resources. Thus people would like the local village council or panchayat to be authorized to regulate and levy collection fees for harvests of medicinal plants from areas under their jurisdiction, including reserve forest areas. The management strategies proposed by the people also emphasize the need for creating local level workable institutions such as village Forest Protection Committees for the management of local natural resources.

The significant aspect of this data would be trade and processing of biological produce which should become the major focus of the studies in towns and cities. Today no detailed information is available on changes in the composition of marine fish landings in the country. Nor is there a data base on trade in medicinal plants within the country, or their export through major ports. Students in cities like Mangalore or Mumbai could learn a great deal in the process of generating such information.

The effective organization of such information would be greatly facilitated by vertical as well as horizontal co-ordination amongst the educational institutions. We may then visualize a Junior College interacting with several High Schools, and a Degree College with several Junior Colleges in its locality. At each higher level, the students could both cross-check the data collected at the lower level and add further information as an exercise conducted by themselves. For instance, the High School students may merely record local names of various crop varieties, Junior College students may record the morphological characteristics of each crop variety in some detail, the degree college students may conduct some simple biochemical analyses as well. Similarly the High School students may record wild species of only flowering plants, Junior College students may also record ferns, mosses, lichens, while the Degree College students may try to assess some additional groups such as soil fungi. The degree college may be an appropriate level at which to transcribe the information from Indian languages into English.

The details of what is worthwhile to look for and how to record it would obviously vary from district to district, say from a hilly, forested district like Churchandpur in Manipur to a dry, plains district like Anantapur in Andhra Pradesh. They may also vary within a district from taluk to taluk, say from the coastal taluk of Karwar with its rich marine life, to the plains taluk of Haliyal in the Uttara Kannada district of Karnataka. A system of biology education with a significant component of investigation of local biological diversity will therefore have to be more flexible than the present classroom based system; it will however, be far more meaningful to the students and teachers, and generate much information of practical value. The vigorous network of peoples' science movements that brings together organizations like Karnataka Rajya Vigyan Parishat or the Kerala Sastra Sahitya Parishat could play a significant

role in catalyzing such a transformation of the educational process (Box 20: The hierarchy of tasks and responsibilities for managing biodiversity resources, information and financial flows at different spatial scales).

17.5 People's Environment Register

This system of People's Biodiversity Registers could at the next step serve as a nucleus of a broader effort to develop People's Environmental Registers (PER). Such PERs could go beyond the recording of biodiversity resources of actual or potential use to other elements of biodiversity that may deserve to be controlled such as crop pests and diseases, livestock diseases and vectors of human diseases such as mosquitoes and fleas. The PERs should also record information on non-living components of the environment such as levels of ground water, development of erosion gullies, siltation of stream and lake beds, soil, water and air pollution. Amongst other purposes these could focus on the negative impacts of physical and chemical factors on biodiversity resources, for instance, impact of air pollution from a cement plant on local vegetation, or of effluents from a rayon mill on fish diversity.

In fact, the human capacity built through these PER exercises could be very useful in initiating a participatory process of environmental impact assessment (EIA). The current system of EIAs is seriously flawed. Such assessments are prepared by one or more technical consultants paid for by the concerned project authorities. Consequently, the consultants are under pressure to minimize their estimates of adverse impacts; in fact, they often serve to merely whitewash the whole project. In its place we must institute a system directly accountable to the public. Such a system could in part be based on preparation of EIAs as a component of the annual updating of the PERs by all Panchayats or Nagarpalikas likely to be affected by the project under appraisal. Such exercises would be highly cost effective; these costs could be charged to the concerned project. Such grass-roots level participatory environmental impact assessment would, however, need to be supplemented by more detailed technical assessment which could be undertaken by a technically competent consultancy organization. But the public should have full access to its findings along with public hearings in which other concerned and technically competent people could participate to ensure the objectivity and usefulness of the exercise.

Box 20

The hierarchy of tasks and responsibilites for managing biodiversity resources, information and financial flows at different spatial scales.

Spatial scale	Tasks envisaged	Implementation agencies/mechanisms
1. Village	a) Preparation of PBR	Local students-teachers
	b) Conservation of biodiversity in private lands of residents, common and public lands and waters within the revenue boundaries of village	Residents of the village, hamlet/settlement
2. Panchayat	a) Maintenance and validation of PBR	Gram Panchayat with local students
	b) Levy collection fees for commercial use of biodiversity resources of public lands and waters	Gram Panchayat in consultation with taluk biodiversity cell and NGOs
	c) Assigning grants to constituent villages and rewarding individuals and user groups on the basis of PBR	Gram Panchayat through a transparent process
3. Taluk	a) Compilation of PBR	Taluk Biodiversity Cell with degree colleges
	b) Rechecking and validation of compiled PBR data	Taluk Biodiversity Cell with degree colleges and parataxonomists
	c) Storage of data - textual, specimens, aids to identification	Taluk Biodiversity Cell with degree colleges, computerisation of data

Spatial scale	Tasks envisaged	Implementation agencies/mechanisms
	d) Conflict resolution and redressal of grievances	Taluk Panchayat in consultation with Taluk Biodiversity Cell and NGOs
	e) Value addition to PBR data	Research by Taluk Biodiversity Cell and degree colleges
4. District	a) Methodology tc be followed in PBR preparation, including curriculum of high school and P.U.C. level	Designed by District Biodiversity cell periodically as per its requirements
	b) Compilation of taluk level data on PBR comparing with existing scientific knowledge and further validation of PBR.	District Biodiversity Cell with post graduate centres and research institutions
	c) Further research on data and material from PBR.	R&D institutions, colleges, universities in collaboration with commercial interests and District Biodiversity cell
	d) Devolution of funds to gram panchayats.	By Zilla Parishads on the basis of indicators recorded in PBR
5. State	a) Norms for MTA, ITA with respect to claims recorded in PBRs	To be evolved in consultation with commercial interests, NGO's, indigenous people

Spatial scale	Tasks envisaged	Implementation agencies/mechanisms
	b) Set priorities of data collection for PBR	State Biodiversity Cell with professional consultation regarding commercial prospects
	c) Devolution of funds to Zilla Parishad	By State government based on data contributed by District Biodiversity Cell to data bank of State Biodiversity Cell
	d) Fostering close co-ordination with government agencies, Panchayat Raj institutions, commercial interests, scientific and R&D institutions	Mechanisms to be set up by the state government
6. Nation	a) Norms for MTA, ITA with foreign enterprises	To be evolved in consultation with enterprises, technical experts, NGOs
	b) Levy Biodiversity Conservation Cess	By central excise department as per advice of National Biodiversity Cell
	c) Devolution of funds to State	On the basis of biodiversity stock level and recording of folk level knowledge
	d) Fostering close coordination with government agencies, Panchayat Raj Institutions, commercial interests, scientific and R & D institutions	Mechanisms to be set up by central government

Spatial scale	Tasks envisaged	Implementation agencies/mechanisms
	e) Constructive participation in international forums, agreements like GATT, CBD to further national interests	Such national interests should take into consideration priorities of commercial interests, indigenous people, through a consultative process
7. International	a) IPR protection to biodiversity based enterprises	As per the provisions of GATT, administered by WTO
	b) Mandatory disclosure of origin of genetic material and public knowledge systems	To be proposed by conference of parties to CBD
	c) Assigning countries of origin for genetic resources	Clearing house mechanisms
	d) Creation of a global bio-diversity fund based on national contributions from a cess on sale of biodiversity based products in each country	To be proposed by conference of parties to CBD

18

Biodiversity Cells—Structure and Financing

18.1 Structure and management

Such a flexible programme, building on available teacher and student power, would not require excessive financial outlays. But to be of practical value, it needs to be scientifically supported, co-ordinated and properly managed. The State Councils of Science and Technology with affiliated District Councils of Science and Technology should be assigned the responsibility of such co-ordination, careful assessment and management of information. For this purpose a Biodiversity Cell should be established at the State Council as well as in each of the District Councils. The cells at the state as well as at the district levels should be physically housed in some research institution, university department or degree college and be manned by biology teachers/agricultural scientists/foresters on deputation. These state and district level cells may also, with profit work in co-ordination with the appropriate units of the Natural Resource Data Management System of the Government of India's Department of Science and Technology.

The State Biodiversity Cell should also work with relevant institutions, such as Germplasm Projects at Agricultural Universities, Regional Stations of the National Bureau of Plant Genetic Resources or Zoological Survey of India, University Life Sciences Departments or R & D units of biodiversity based enterprises such as pharmaceutical companies. It could provide for an appropriate fee, information required by such institutions, or exchange information on the basis of some mutual understanding.

At the national level, an analogous Biodiversity Cell may be set up in some appropriate national organization such as the National Bureau of Plant Genetic Resources, again without any permanent staff or long term Government funding, on the condition that it become self-supporting through charging for access to information supplied or services provided. It should provide the

highest level of scientific support to and also co-ordinate the management of reliable biodiversity related information with all state level cells as well as national level agencies.

18.2 Self-financing: Ways and means

Again these cells should be promoted to function in such a way as to rapidly become self-financing. They could do so by charging fees for access to information of different degrees of reliability. For instance, the information on cultivars of crops which survived an outbreak of a fungal disease could be quite reliable and of immediate value to seed companies, while information on a plant reported to be a cure against hepatitis may be no more than a pointer for a pharmaceutical company. The pharmaceutical company may even be interested to learn of a claim that a certain individual in a particular village, or a whole tribal group may be aware of a cure against asthma or malaria, although the source of the remedy has not been disclosed. The company may then enter into a material and/or information transfer agreement with that individual, or that tribe to take up research for possible commercial application. Initially the company may merely receive an acetone extract, without being advised of the identity of the plant, for a small fee. If this is found promising, it may pay a larger fee for fuller information, and even enter into an agreement for payment of some royalty. The local Panchayat may be legally entitled to a fraction of such fees or royalties. In operationalizing this, legal or technical help would often be required by the local health practitioners or tribals. Such help could be provided by the District Biodiversity Cell for a small fee. The IPR legislation that India develops must promote the possibilities of such arrangements. The Biodiversity Cells could also be financed through service charges paid for carrying out assessment of the impact of some development project, or pollutant from some industry on biodiversity.

18.3 Problems with royalty payments

This system does not visualize any direct share in royalties from commercial use of biodiversity to individuals or communities except when indicated by specific material or information transfer agreements. It does not, for instance, propose that farmers cultivating brackish water rice varieties such as Kagga should directly get some royalty from a seed company that uses a Kagga gene.

It also does not suggest that a pharmaceutical company marketing a drug based on some tribal medicinal knowledge should pay royalty to those tribals. In its place it suggests that special awards may go to farmers who cultivate unusual paddy varieties such as Kagga, or tribals who may have recorded an extensive number of eventually useful medicinal plants in the People's Biodiversity Register. The reason for rejecting the proposal to link royalties with community level maintenance of a cultivar, or knowledge of medicinal properties is that it is well nigh impossible to pinpoint recipients of the royalty in the absence of specific material or information transfer agreements.

To attempt to organize royalty payments on a wide scale unless they are part of specific MTAs or ITAs would call for a great deal of highly sophisticated and expensive technical investigative work, and even then it might often be difficult to prove, for instance, that a specific gene for salt resistance, came from a particular Kagga variety in coastal Karnataka, or that the clue for the development of a specific drug came from a particular tribal practice. Even if this is accomplished, it would be difficult to delineate a particular set of individuals who should receive the royalty payments. Given such difficulties the whole process would get bogged down in endless legal squabbles. The system we suggest instead involves payment of a straightforward cess by biodiversity based enterprises, or polluters and its disbursement through grants and awards in a transparent fashion. This is a system far less likely to get embroiled in futile disputes, yet would serve to transfer part of the profits accruing from biodiversity based enterprises to people contributing to the conservation of biodiversity and knowledge of its sustainable use. We believe this to be the most workable and fair system.

The proposed system of managing biodiversity information would thus work closely with biodiversity based enterprises and educational and scientific institutions to generate in a self-sustaining fashion, quality information to promote enterprise. But this system would also serve two other important functions, namely to highlight non-sustainable uses, or other developments adverse to biodiversity, and to guide in the appropriate sharing of benefits flowing from biodiversity based enterprises, with local communities.

19
Role of Panchayats

19.1 Decentralising natural resource management

The distribution of biological diversity is extremely heterogeneous in space and time. It is therefore very difficult for a centralized system to monitor what is going on at the ground level. Such monitoring would require a decentralized system of collecting information as well as management. We have outlined above the possible structure of a decentralized system of collecting and organizing information. The Panchayat Raj and Nagarpalika institutions are obviously the appropriate decentralized systems of governance to use this information towards sustainable management of biodiversity. Such institutions are, or will soon be, functional in all parts of the country apart from some scheduled tribal areas of the Northeast. Other parallel institutions such as tribal and district councils serve a similar function in these Northeastern states. It is these local systems of Government that are most appropriate for management of local stocks of both natural and domesticated biodiversity (Box 21: Constitutional provisions for local self governance—Panchayats and Nagarpalikas).

Such involvement of decentralized institutions of governance would be greatly helped by creating a system of positive incentives for the local communities to conserve, sustainably use, and if possible enhance the biodiversity levels in the areas falling within their jurisdiction. This jurisdiction should include private lands (which of course will remain under the control of private owners who would directly collect any appropriate collection fees), revenue lands and public water areas to be managed entirely by Panchayat Raj institutions, as well as reserved forest lands whose timber resources would continue, at least for the present, to be managed by the Forest Departments, while all the non-timber biological produce, including medicinal herbs and minor forest produce like soapnuts or sal seeds could come immediately under the management of Panchayat Raj institutions. This is already the case for the Scheduled Tribal Areas of Central India under the provisions of the Extension of Panchayat Raj Institutions to the Scheduled Areas Act of 1996.

Box21

Constitutional Provisions for Local Self Governance—Panchayats and Nagarpalikas

The 73rd and 74th Constitutional amendments enacted by the Parliament in 1992 confer constitutional status on all local self government institutions and provide a framework for state level legislation.

1. The 73rd amendment dealing with rural local self government institutions has the following provisions.

   Under Art 243G, The State legislature should devolve powers and authority to the rural panchayats to enable them to function as institutions of self government, provisions have also to be enacted for the devolution of powers and responsibilities for the preparation of plans and implementation of schemes for economic development and social justice by panchayats on various subjects entrusted to them including those in relation to the matters listed in the Eleventh Schedule.

   1.1 The Eleventh Schedule entrusts a total of 29 subjects to panchayats which include: 1) Agriculture, 2) Horticulture, 3) Animal Husbandry, 4) Fisheries Development, 5) Soil and Water Conservation, 6) Social and Farm Forestry, 7) Wasteland Development 8) Cottage Industries, 9) Village Sanitation and Planning, 10) Primary Health Care, and 11) Education (including adult literacy).

2. Art 243 H pertains to the financial resources for the rural panchayats. The state legislature may both authorise the panchayats to levy, collect and appropriate certain taxes, duties, tolls, fees etc and also assign to panchayats revenues of certain state level taxes subject to such conditions imposed by the state. Further, grants-in-aid may also be provided to panchayats. The state legislature may also require setting up funds for crediting all money received by the panchayats and for their withdrawals.

3. Art 243I - provides for institutional arrangements to periodically review the financial position of panchayats. The state legislature should provide for composition and working of a finance commission within one year and thereafter every fifth year.
4. Art 243M - stipulates that all states with certain exceptions (as per sec.244) must have a three tier panchayati raj systems with panchayats at village, intermediate and district levels. The state legislature has to choose the intermediate level. In each village there should also be a 'grama sabha' consisting of persons who are registered in the electoral rolls of the village.
5. The Art 243Q 74th amendment envisages three types of municipalities in urban areas.
   a. Nagar Panchayat—Areas in transition from rural to urban area.
   b. Municipal Council—for smaller urban areas.
   c. Municipal Corporation—for larger urban areas.
6. Under Art 243W, provisions similar to rural panchayats are made for devolution of powers, responsibilites and authority by the state legislature to Municipalities. There are 18 subject matters listed in twelfth schedule which include:
   1. Regulation of land use and construction of buildings
   2. Public health, sanitation and solid waste management
   3. Urban forestry, protection of environment and promotion of ecological aspects
   4. Promotion of cultural, educational, aesthetic aspects.
7. Under Art 243X and Art 243Y provisions similar to rural panchayats are made regarding financial arrangements for municipalities and constitution of finance commission to periodically review such arrangements.
8. Art 243ZD - lays down institutional set up at district level for consolidating plans prepared by the panchayats and municipalities

in the district and preparing a district development plan for the district as a whole. It further outlines the various provisions to be provided by the state legislature regarding composition and functioning of the District Planning Committee.

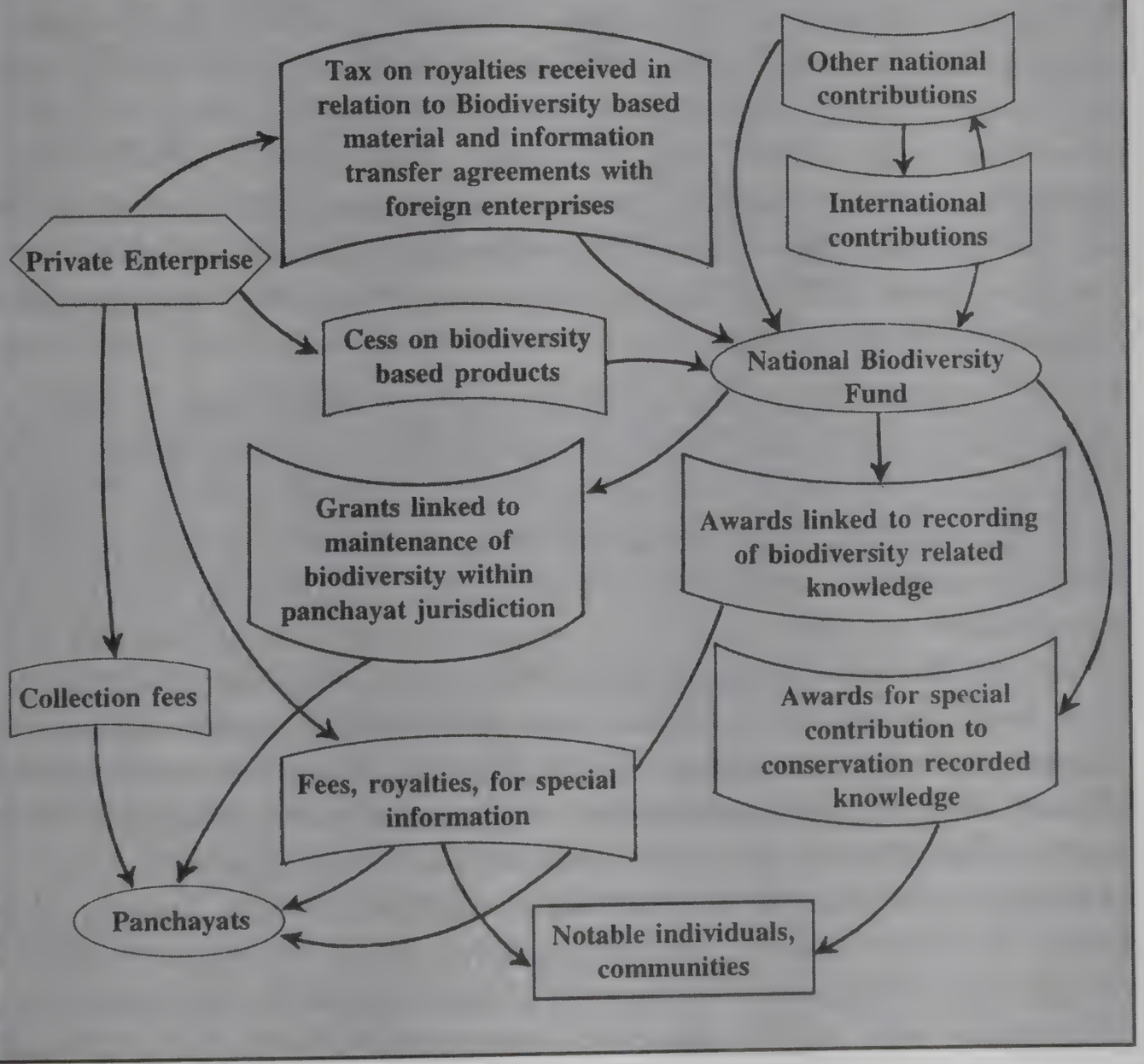
9. Art 243ZE constitutes a further separate institutional set up for metropolitan areas, which have a population of 20 lakhs or more and are specified as metropolitan areas by state governments. The Metropolitan Planning Committee should prepare a draft development plan for the metropolitan area as a whole. The state legislature should by law make provision for various specified aspects regarding composition and functioning of Metropolitan Planning Committee.

Panchayat Raj institutions should then have full control over exploitation of non-timber biological resources from all these public lands and waters within the revenue boundaries of their constituent villages and have the right to levy collection fees for commercial use of any of these resources. Such collection fees would be a very appropriate addition to local revenue generation by the Panchayats. It would motivate them to encourage sustainable use of such resources, since overuse will reduce future revenue. It would motivate them to encourage local people along with local High Schools to properly monitor stocks of such resources, and thereby promote effective implementation of this component of school science teaching. It would also encourage Panchayats to try and obtain information on end uses and market prices of these products to assess appropriate levels of collection fees. Higher level educational institutions such as degree colleges would be involved in collecting this information on trade and processing of biological produce. Panchayats would thereby be encouraged to develop links with them and with the District Level Biodiversity Cells to access such information serving to enhance awareness and positive action for managing biodiversity. In turn the Taluk and District Level Biodiversity Cells would collate the information on the collection fees levied on all the various biodiversity resources from each of the constituent Panchayats through the Junior and Degree Colleges. This would create a very effective system

of monitoring biodiversity use, so essential for sustainable management. For this system to function well, the Panchayat Raj institutions should be involved in supervising the work of educational institutions and biodiversity cells at Taluk and District levels as well (Box 22: Financial mechanisms for rewarding conservation efforts at grassroots level).

Box 22

Financial Mechanisms for Rewarding Efforts at Grassroots Level


Tax on royalties received in relation to Biodiversity based material and information transfer agreements with foreign enterprises
Other national contributions
International contributions
Private Enterprise
Cess on biodiversity based products
National Biodiversity Fund
Grants linked to maintenance of biodiversity within panchayat jurisdiction
Awards linked to recording of biodiversity related knowledge
Collection fees
Awards for special contribution to conservation recorded knowledge
Fees, royalties, for special information
Panchayats
Notable individuals, communities

19.2 Special grants and awards

Collection fees would only reflect the use of biodiversity elements in commercial demand at any given time. It is essential to create further positive incentives for Panchayat Raj institutions to maintain high levels of stocks of biodiversity, as well as records of practical ecological knowledge of uses of such biodiversity. This should take the form of special grants and awards from the Government to Panchayat Raj institutions, other institutions such as fisherfolks', shepherds' or forest labourers' co-operatives and to individuals. The funds for the grants and awards should come from a Biodiversity Cess levied on the sale of all biodiversity based products such as seeds, pharmaceuticals and cosmetics, cess levied on polluting industries or civic bodies responsible for the depletion of biodiversity resources as well as on any royalty payments being made in consequence of Material Transfer Agreements with foreign enterprises. To this fund, may be added, contributions coming from outside India to promote or reward biodiversity conservation. This could include a share of the biodiversity cess levied in other countries coming to India in proportion to sale of IPR protected products for which India is the country of origin, or other grants. The Government of India may also add revenue from other sources to this National Biodiversity Fund.

The quantum of grant to any Panchayat or Tribal District Council or Municipal Council from the National Biodiversity Fund should be proportionate to the stock of biodiversity within the jurisdiction of that institution. Such an assessment could be based on the documentation of levels of biodiversity by educational institutions building upon the People's Biodiversity Register with consolidation and addition of further information at Taluk and District level as suggested above. Appropriate checks will have to be devised to ensure that these levels are not falsely inflated through institutions from neighbouring villages, taluks, districts or states. The district level Paryavaran Vahinis of the Ministry of Environment and Forests with extensive involvement of local NGOs and people may also play an important role in monitoring the validity of these records. Since it is impossible to monitor levels of diversity in all groups of microbes, plants and animals, some choice will have to be made of appropriate indicators at the national and state levels through broad based consultations with experts. But it is entirely possible to devise a workable

system of linking special grants to Panchayats with the levels of biodiversity within their jurisdiction. By and large it is true that levels of poverty are higher in areas rich in biodiversity, be they areas under extensive forest cover or subsistence rainfed agriculture. Linking such grants to the levels of biodiversity would then not only motivate sustainable use, conservation, and if practicable, enhancement of biodiversity, but would also promote equity.

These grants may go primarily to Panchayat Raj institutions. But not all groups or individuals within the ambit of a Panchayat may make equal contributions to the maintenance of biodiversity. There may be institutions such as fisherfolks' co-operatives that may play a special role in protecting biodiversity along the sea coast. There may also be individuals who may be notable, for instance, for maintaining mango trees belonging to a number of varieties on their farm. A portion of the National Biodiversity Fund, say 10 per cent may be set aside to recognize and specially reward such individual or group efforts throughout the country.

This series of arrangements would motivate individuals, groups and village communities to maintain high stocks of biodiversity. Knowledge of use and management of such biodiversity being equally important, it is proposed that this also be documented along with information on the levels of biodiversity. It would be appropriate to reward individuals and communities who make notable contributions to such a pool of knowledge. Those who prefer to withhold their knowledge, through only entering claims would, of course, not be eligible for such rewards. Another fraction, say 10 per cent of the National Biodiversity Fund should be set aside for special awards for the recording of such knowledge.

We believe this to be a consistent, comprehensive and workable system that would overcome many of our current weaknesses and serve to at once promote conservation and sustainable use of biodiversity, growth of biodiversity related knowledge, and of biodiversity based enterprises. It would also promote equity by creating a stake for, and rewarding the weaker sections of the Indian society living close to the earth for conserving biodiversity, often the mainstay of their livelihoods.

20
In Tune with the Times

20.1 Growth with equity

This would be a positive approach, an approach striving to involve all segments of society to conserve, use and benefit from our country's rich heritage of biological diversity. It is in consonance with our national agenda of stimulating economic growth, of promoting social justice, of fostering ties with our Asian neighbours, of caring for our environment. It would help economic growth by enhancing the efficiency of use of natural and informational resources, and by organizing the conservation effort in a cost effective fashion. This would be achieved by sharing resource control more meaningfully with those segments of Indian society who have a real stake in maintaining a healthy resource base. It would be achieved by promoting a much more open, transparent system of resource management in which waste and misappropriation would be exposed and checked. It would be promoted by feeding better quality, timely and locality specific information in a flexible system of resource management. Economic efficiency would also be enhanced by organizing the biodiversity conservation effort through involving the weakest sections of our society, people who would be willing to deliver goods at low levels of compensation as the custodians.

The proposed system would foster economic growth by providing easily accessible reliable information pertaining to biodiversity based enterprises. It would help economic growth by encouraging enterprises to involve themselves in research and development efforts by putting in place an effective intellectual property rights regime, which would at the same time guard the interests of the traditional custodians of India's biodiversity and knowledge of its uses.

This approach would enhance equity, and promote social justice not only through channelising enhanced levels of flows of funds to the weaker segments of our society, but also by conferring on them dignity by respecting their knowledge and empowering them to manage their own affairs and conserve and manage the country's biodiversity resources. The direct financial flows to the weaker sections of the society would be enhanced by promoting their involvement

in local level value addition to biodiversity resources and improving their marketing capabilities, including marketing of information relating to uses of biodiversity, and by awarding them for individual or community level efforts towards conserving biodiversity and recording knowledge of its uses. The weaker sections would also benefit through more secure livelihoods with greater control over the local base of natural resources.

The system outlined would also strengthen the gram panchayat system financially by authorizing it to levy collection charges on harvests of local biodiversity resources, and to collect fees from biodiversity enterprises via material or information transfer agreements. The gram panchayats doing well in terms of conservation of biodiversity resources or recording of information pertaining to their uses could also attract awards. All these additional financial resources at the lowest level of self-government ought to further help the weaker segments of our society.

We suggest an active involvement of the local communities in the educational process through regular monitoring of the local biodiversity and other natural resource base, and public health environment—including crop pests, livestock diseases and vectors of human diseases. Such an emphasis on first hand observations respecting the knowledge base with local communities ought to inject fresh vigour in the educational system at the grassroots level and promote efforts at the spread of literacy. The information generated in such exercises should help enhance agricultural and livestock productivity through use of better information for the management of crop and animal diseases. It should also help improve human health by catalyzing more effective control of vectors like mosquitoes. Finally, our proposed system would promote the cause of a better environment in many ways. It is a system that would provide positive incentives for maintaining, indeed newly promoting a biodiversity rich milieu throughout our countryside. The countrywide system of environmental monitoring that it suggests should also help in maintaining a healthier environmental regime everywhere.

20.2 Moving away from exclusion

The system we propose visualizes a transition from a system grounded in exclusion or in patronage without accountability, to a system based on empowerment coupled to patronage linked to accountability. The exclusion

being practiced currently involves many components: exclusion of the masses from any control or participation in the management of the natural resources of the countryside; exclusion of their knowledge, their traditional health practices, their traditional conservation practices from any claim to legitimacy; exclusion of the people from any knowledge of governmental policies and action; exclusion of any contacts with the real world in the system of education. All of this exclusion serves the vested interests of a narrow elite. So while none of it promotes any broader national interests, it persists as an elaboration of the legacy of colonial days, as a form of internal colonialism. It is, of course, being resisted and there are signs here and there of welcome breaches. These are evident in the institution of programmes like Joint Forest Management, or Water Users' Groups in command areas; in the gradual strengthening of the Panchayati Raj institutions, in the vigorous support to the Literacy Mission and in the increasing access to information through public media.

20.3 Rejecting leaky patronage

Our proposal seeks to suggest a system of meaningful empowerment of the large masses of Indian people. Today the state apparatus being in total charge of the development process, controls the natural resource base of the entire country. Our forest departments are the country's biggest landlords, controlling one fifth of the land mass. The minor and major irrigation departments rule over the surface waters. Bureaus of mines, coal authorities, oil corporations control mineral wealth. The state has draconian powers to acquire private lands and displace poor peasants and tribals without providing them alternative livelihoods. So the ongoing development process is one of the state controlling all natural resources, organizing their exploitation, more often than not in non-sustainable, wasteful ways, leaving the local communities high and dry. This apparatus then attempts to alleviate rural poverty by providing a variety of handouts. It also tries to deliver health care and education to the masses. This whole process of organizing state patronage, devoid of any accountability, is so riddled by corruption that much of what is expected to percolate down is lapped up on the way.

Such an approach could only have been justified if the state were genuinely serving the cause of equity; if it were using resources so mobilized to help poor

people at the cost of the rich, to develop poorly endowed regions at the cost of the richer regions. Far from doing this, the state apparatus is engaged in taking bamboo away from basket weavers who have depended on it for generations for a livelihood, and handing it to paper mills at throw away prices. It is engaged in throwing out tribals of Madhya Pradesh to construct dams that will benefit the sugar barons of Surat. All of this has tended to worsen social inequities and regional disparities.

It would, in these circumstances, be best to hand back to local communities control over the local natural resources of land, water, minerals, of trees, medicinal plants and fish, and then help them manage these resources carefully, reap their benefits and use these to acquire whatever services they want—whether this be clean drinking water, maternity care, school or college education or entertainment. It may be argued that local communities are incapable of managing these natural resources on the grounds that rural communities are divided along many lines of caste and class, have no technical competence, and cannot see far in the future. It may also be said that tree cover has been destroyed much more in protected forests to which rural communities had access than in reserve forests in which their access was controlled. In part these points are well taken. Rural communities cannot, on their own organize proper extraction and marketing of, say, milk or petroleum, and would need outside technical support. This is certainly so, but the experience of Amul Dairy tells us that poor peasants can become partners of a highly professional enterprise if given adequate technical support. It is also true, as the West Bengal experience of joint forest management shows, that they could manage forests as well as or better than the state apparatus if organized to do so. However, villagers with open access to protected forests are today in no way equipped to manage these areas. There are no resources, no institutions and no laws to help them keep out outside commercial interests, nor to regulate the behaviour of any member of their own community out to liquidate these assets. They are literally in charge of no-man's and no-woman's lands. It is only to be expected that such lands would be worse off than reserve forest lands where a powerful bureaucracy, equipped with well framed laws is paid handsomely to guard and sustainably use the forest stock. The fact is that in a few exceptional cases, such as in some Ban Panchayats of Kumaon, the forest is far better preserved than in tracts of reserve forests. The sacred grove of Bhimashankar in Maharashtra

has far richer diversity of plant species than in any nearby reserve forests. All this only goes to show that our people have the potential to prudently use the country's natural resources, a potential they have largely failed to realize in the absence of adequate institutional and legal support.

20.4 State as a catalyst with accountability

Many advocates of *status quo* ignore this vital point and equate the demand for real empowerment with merely handing over control to local communities, which is, of course, inadequate. The larger society must help local communities through providing appropriate institutions that would link local self government best equated with gram sabha or assembly of all adults at the village level with democratic structures of governance at village cluster, taluk, district, state and national levels. These higher level institutions must help the lower level institutions in law enforcement, in redressal of grievances and in the resolution of conflicts. Higher level institutions should also provide financial incentives for local communities to undertake actions in the larger interest, such as continuing protection to sacred monkeys even when they destroy valuable crops. Higher level institutions must support endeavours such as local level value addition to biodiversity resources through technical inputs. Rejecting modern science and technology would be suicidal. We must, on the other hand, encourage our modern scientific establishment to be more socially responsible and alive to Indian challenges—to help document our own biodiversity and establish symbiotic relations with practical ecological knowledge and classical systems like Ayurveda and Yunani.

There is then a need to complement empowerment with patronage—but this should not be patronage without accountability, so liable to degenerate into waste and corruption. We must make the transition to a transparent system of patronage, open to public scrutiny and accountable to those it is intended to benefit. We have endeavoured to sketch how such a system might be devised by linking it to the newly emerging system of Panchayati Raj. We believe that this route of empowerment of the masses coupled with a system of patronage with full accountability is the path that would lead us to economic efficiency, to social equity and to a healthy environment rich in biodiversity.

Suggested Reading

Chapter 1

Anon, 1994. General Agreement on Tariffs and Trade (GATT)-Final Text of Uruguay Round. World Trade Centre, Mumbai.

Glowka L. 1998. A Guide to designing legal frameworks to determine access to genetic resources, IUCN, Gland, Switzerland.pp. xii+98.

UNEP-CBD. 1991. Convention on Biological Diversity (CBD), Secretariat on CBD, United Nations Environment Programme, Montreal.

Chapter 2

Gadgil, M., M.D. Subhash Chandran, P. Pramod, U.Ghate, P. Iyer, Y. Gokhale, D. Winfred Thomas & P. Menon. 1996. People's Biodiversity Register: Recording India's Wealth. *Amruth*, vol 1 (5). pp.1-16.

Sukh Dev, 1997. Ethnotherapeutics and modern drug development: The potential of Ayurveda. *Current Science*, Vol 73, No.11, 909-928.

Chapter 3

Dasmann, R.F. 1988. Toward a biosphere consciousness. In the Ends of the Earth, D. Worster, ed., Cambridge University Press, New York, pp. 277-288.

Gadgil, M. and R Guha. 1992. This Fissured Land: An Ecological History of India. Oxford University Press, Delhi and University of California Press, Berkeley.

Ludwig, D., R. Hilborn and C. Walters. 1993. Uncertainty, resource exploitation and conservation: lessons from history. Science 260: 17, 36.

Shrader-Frechette, K.S. & E.D. McCoy. 1993. Method in Ecology: Strategies for Conservation, Cambridge University Press.

Chapter 4

Gadgil, M, and R Guha, 1996. Ecology and Equity: Use and Abuse of Nature in Contemporary India. Penguin, New Delhi, pp.213.

Chapter 5

Kothari Ashish, Neera Singh, Saloni Suri. 1996. People and Protected Areas: Towards Participatory Conservation in India. Sage Publications. New Delhi, pp. 276.

Kothari Ashish, 1997. Understanding Biodiversity: Life Sustainability and Equity. Orient Longman, pp. 161.

Kothari Ashish, Neema Pathak, R.V. Anuradha, Bansuri Taneja, 1998. Community based conservation: Natural Resource Management in south and central Asia. Sage publications, New Delhi, pp.505.

Ramakrishnan, P.S., K.G. Saxena, U. M. Chandrashekhara (ed.), 1998. Conserving the sacred for biodiversity management. Oxford and IBH. New Delhi. pp. 480.

Chapter 7

Gadgil, M., Shri Niwas Singh, Harini Nagendra and M.D. Subash Chandran. 1996. Guidelines for in-situ Conservation of Wild Relatives of Cultivated Plants and Related Taxa of Cultivated Plants. FAO, Rome and IISc, Bangalore.

Chapter 8

Gadgil, M. and P. R. S. Rao. 1995b. Designing incentives to conserve India's Biodiversity. In S. Hanna and M. Munasinghe editors. Property rights in a social and ecological context. The Beijer International Institute of Ecological Economics and the World Bank, Washington D.C. pp 53-62.

Chapter 9

Gadgil, M. and P.R. S. Rao. 1994. A system of positive incentives to conserve biodiversity. Economic and Political Weekly, Aug. 6, pp.2103, 2107.

Gadgil, M. and P.R.S. Rao. 1995. People's Bill on nature, health and education. Economic and Political Weekly, pp. 2501-2512, October 7.

Ostrom, E. 1990. Governing the commons: the evolution of institutions for collective action. Cambridge University Press. New York.

Poffenberger, M. and B. McGean (ed.) Village Voices, Forest Choices: Joint Forest Management in India, Oxford University Press, Delhi.

Singh, K. 1994. Managing common pool resources. Oxford University Press.

Chapter 10

Pramod, P., R. J. Ranjit Daniels, N.V Joshi & M Gadgil. 1997. Evaluating Bird Communities of Western Ghats to plan for a biodiversity friendly development. *Current Science*, Vol. 73, No, 2, 156-162.

Chapter 11

See Ch. 1

Chapter 12

Lesser, W. 1998. Sustainable Use of Genetic Resources under the Convention on Biological Diversity: Exploring the Access and Benefit Issues. CAB International, UK. pp xii, 218.

Chapter 13

Gadgil, M. and P. Devasia. 1995. Intellectual Property Rights and Biological Resources: Specifying Geographical Origin and Prior Knowledge of Uses. *Current Science*, Vol. 69, 637-639.

Chapter 14

Gadgil, M. 1997. A framework for managing India's Biodiversity, RIS Biotechnology and Development Review. 1(1):1-14.

Swaminathan, M.S. 1995. Farmer's Rights and Plant Genetic Resources-Recognition Reward: A dialogue. Macmillan. Chennai.

Chapter 15

Dutfield, G. 1997. Can the TRIPs agreement protect biological and cultural diversity? Biopolicy International Series No. 19. African Centre for Technology Studies. Nairobi.

Gadgil, M. 1998. Conserving Biodiversity: Where are the people? The Hindu Survey of Environment, pp. 101-148.

Posey, D. & Dutfield, G. 1996. Beyond Intellectual Property: Towards Traditional Resource Rights for Indigenous Peoples and Local Communities, IDRC (International Development Research Centre). Ottawa. pp. XV, 303.

Shiva Vandana, 1993. Monocultures of Mind: Biodiversity, Biotechnology and the third world. Third World Network, Malaysia.

Chapter 16

Gadgil, M. 1996. Documenting Diversity: An Experiment. *Current Science*, Vol. 70, 36-44.

Gadgil, M. 1996. Deploying Student Power to Monitor India's Lifescape. *Current Science*, Vol. 71, 688-697.

Index

A

Adult literacy 108, 142
Allopathy 14
Amazon 22
Amul Dairy 151
Andamans 112
Anthropological Survey of India 19
Aquaculture 127
Aravallis 106
Arthsasthra 38
Assam 33, 118
Australia 73, 81
Ayurveda 14, 15, 16, 17, 18, 47, 80, 126, 152

B

Bamboo 8, 26, 27, 29, 30, 32, 33, 151
Ban Panchayat 151
Bandipur Tiger Reserve 44
Bangladesh 82, 83, 98
Barefoot ecologist 108
Barry Bloomberg 16, 17
Bhimashankar 151
Bhuria Committee 59
Bhutan 82, 83
Bihar 25, 118
Biocon 97, 104
Biodiversity, conservation 51, 56, 94, 95, 96, 118, 136, 146, 148
, management, conservation cess 94, 136
, incentives for conservation 55, 57, 60, 67, 72, 141, 146
, information system 61, 103, 107, 108, 117, 118
, resources 2, 4, 5, 7, 62, 79, 87, 92, 100, 121, 122, 123, 124, 126, 127, 128, 129, 130, 131, 144
, sustainable use 46, 116
Biodiversity Conservation Prioritization Programme 118
Biosphere people 21, 27

Biotechnology 7, 8, 75, 78, 80
Botanical gardens 91, 103
Botanical Survey of India 19, 105
Brazil 9, 22, 73, 79, 81, 84

C

Carl Linneus 16
Central Drug Research Institute 97, 105
Charaka 14, 18
China 73, 81, 82, 83, 88
Cinchona 84
Clearing house mechanism 92, 93, 137
Co-operative society 127
Community, local 60, 61, 119
, rights of 55, 100
, traditional 5, 11, 12, 19, 20, 60
Composite conservation value (CCV) 69
Conservation value 57, 67, 68, 69, 70, 71, 72, 94
Constitutional amendment, 73rd and 74th 142
Consultative Group for International Agricultural Research (CGIAR) 90
Convention on Biological Diversity 2, 4, 5, 11, 12, 67, 79, 80, 81, 90, 93, 105, 117
Costa Rica 50
Council for Scientific and Industrial Research 97, 99

D

Dabur 97
Dasmann 21
Deo B.N.S 39
Dietrich Brandis 42
District Biodiversity Council 65
DNA finger printing 103

E

Ecological history 44
Ecological refugees 20, 21, 22, 27, 28
Ecosystem people 20, 21, 22, 27, 28, 29, 39, 54
Ecosystem services 59, 60

Enterprises, biodiversity-based 117
Environmental Impact Assessment (EIA) 63, 133
Ex-situ collection 98

F

Fishery 24, 44, 45, 61, 105
Folk knowledge 85, 103, 107, 109
Folk tradition 14
Forest Departments 19, 24, 27, 29, 55, 121, 141, 150
Forest Resource Survey 26
Forest Survey of India 25, 26, 105
Forestry 24, 26, 27, 61, 108, 142, 143
Foundation for Revitalization of Local Health Traditions 118
French Institute 26

G

Gene bank 91
General Agreement on Tariffs and Trade (GATT) 2, 22, 73
Genetic resources 2, 6, 7, 8, 73, 74, 75, 76, 78, 79, 80, 81, 84, 90, 92, 93, 94, 95, 96, 97, 99, 100, 105, 106, 111, 112, 137, 138
Germplasm 79, 105, 138
Ghorpade M.Y 39
Gir National Park 37, 44
Global Biodiversity Conservation Fund 94, 96
Global Environment Facility 94
Goa 25, 33, 109

H

Habitat preference 68, 69, 70, 114
Himachal Pradesh 25, 118
Himalayas 27, 106, 117
Hoechst 97, 100

I

India 1, 4, 8, 9, 10, 12, 13, 15, 16, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 34, 35, 36, 37, 38, 39, 40, 42, 44, 46, 47, 54, 55, 56, 59, 68, 69, 70, 71, 73, 79, 80, 81, 82, 83, 86, 88, 90, 91, 94, 96, 97, 98, 99, 100, 103, 104, 105, 106, 109, 110, 111, 114, 115, 117, 118, 119, 123, 124, 125, 126, 127, 130, 132, 138, 139, 141, 146, 148

Indian Council of Medical Research 20
Indonesia 73, 80, 81, 83, 88
Information Transfer Agreement 96, 139, 140, 149
Intellectual Property Rights (IPR) 86
International Rice Research Institute 79, 88, 90
Intrinsic value 5, 112
IUCN 69

J

Joint management programmes 55

K

Karnataka 25, 26, 33, 34, 35, 40, 42, 43, 65, 90, 99, 102, 109, 118, 121, 124, 126, 132, 140
Karnataka Rajya Vigyan Parishat 132
Karnataka Ryot Sangha 99
Kautilya 38
Keoladev Ghana 38, 39, 44, 45
Kerala Sastra Sahitya Parishat 132
Keystone species 44, 47
Knowledgeable individuals 119
Kudremukh National Park 124
Kumaon 151

L

Lifescape 109, 110
Literacy mission 2, 150
Livestock, grazing 33, 45
Local communities 5, 11, 12, 26, 39, 47, 54, 55, 56, 57, 58, 59, 64, 67, 72, 84, 87, 92, 94, 100, 116, 123, 124, 128, 131, 140, 141, 149, 150, 151, 152

M

Madhya Pradesh 25, 151
Malaysia 73, 79, 81, 83
Manipur 25, 42, 43, 132
Material Transfer Agreement 99, 118, 146
Merck 50

Microorganisms 4, 73, 87
Midnapore 54
Minor Forest Produce 39, 109, 141
Mizoram 25, 43, 109, 112
Multinationals 97
Myanmar 82, 83, 90, 98

N

Nagarpalika 133, 141, 142
NAPRALERT 19
National Biodiversity, Council 66, 67
, Fund 117, 146, 147
National Bureau of Plant Genetic Resources 138
National Commission on Agriculture 24
National Environmental Commission 65
National Park 37, 38, 44, 47, 49, 106, 124, 128, 129
National Remote Sensing Agency 25
Natural Resource Data Management System 138
Nature Conservancy 57
Nature Protection Squad 64
Neem 44, 87, 90, 98, 99, 125
NGO 61, 66, 92, 119, 134, 135, 136, 146

O

Omnivores 20, 21, 22, 27, 28, 29, 30, 39
Orissa 25, 118, 124, 129

P

Pakistan 71, 82, 83, 98
Panchayat 58, 59, 62, 63, 65, 131, 133, 134, 135, 139, 141, 142, 143, 144, 147, 149, 151
Panchayati Raj 49, 67, 143, 150, 152
Paryavaran Vahini 146
Patents 3, 4, 20, 75, 76, 92, 95, 98, 99
People of India project 19
People's Biodiversity Registers 102, 103, 109, 115, 118, 133
People's Environment Registers (PER) 61
Peru 84, 88, 90

Pharmaceutical companies 11, 138
Plywood industry 34, 35, 106
Population assessment, methods of 114
Practical ecological knowledge 11, 47, 58, 80, 107, 121, 125, 146, 152
Primary Health Care 60, 61, 142
Public health 59, 61, 66, 143, 149
Public Works Department 58, 62

R

Rajasthan 25, 36, 38, 47, 118, 128
Ranbaxy 97
Refugia 42, 43, 44
Research and Development (R&D) 135, 136
Rewards, performance-linked 57, 60, 67
Rubber seeds 84

S

Sacred, groves 42, 43, 54, 60, 128
, ponds 42, 60, 116, 128, 131
Salim Ali 38, 39, 44, 110
Satellite imagery 24, 26, 110
Science, fast 14, 15, 16
, slow 14, 16, 115, 117
Sequential exhaustion 34, 35
Siddha system 117
Soil conservation 57, 61
Space Department 24
Species richness 41
Subsidiary Body on Scientific, Technical and Technological Advice 67
Subsidy 30, 31, 34, 46, 48, 57
Sushruta 14

T

Tamil Nadu 25, 117
Taxonomy 69, 70, 110, 111, 113
taxonomic distinctness 69
Technology, access to 6, 75, 76
, transfer of 6, 75, 76, 94, 100
Threatened species 12, 69, 112

Trade Related Intellectual Property Rights (TRIPS) 2, 22, 73
Traditional medicinal system 102
Transgenic animal 87
Turmeric 98, 99, 115

U

United Kingdom 86
United Nations Conference on Environment and Development 79
USA 20, 22
User group 119, 121, 122, 123, 130, 134
Uttara Kannada 29, 30, 32, 33, 34, 35, 36, 40, 51, 52, 132

V

Van Rheede 15, 16, 126
Vietnam 83, 88
Village Forest Committee 2, 55, 124
Village Nature, Health and Education Committee 62
Vocational education 61
Vrikshayurveda 80

W

Water Users' Groups 11, 150
West Bengal 25, 54, 55, 151
Western Ghats 10, 22, 27, 34, 35, 40, 41, 42, 43, 68, 69, 70, 104, 106, 109, 118, 121, 123, 124
Western Ghats Biodiversity Network 41, 118
Wild relatives of cultivated plants 51, 52, 111, 117
World Wide Fund for Nature 118
World Trade Organization 137

Y

Yunani 14, 20, 80, 152

The erosion of biological diversity is one of the most serious environmental issues of our times. An issue that has major economic implications in the context of the exploding opportunities opened up by progress in biotechnologies. India, with the third largest scientific and technical manpower in the world and rated one of the top megadiversity countries, stands on the threshold of enormous possibilities. But is the country equipped to benefit from these opportunities?

This book spells out a clear strategy that aims to garner maximum advantage for India in this transitional phase through playing the economic game while pressing to level the playing field and at the same time moving to conserve the incredible complexity of life-forms housed in this country.

Pointing out where we are going wrong and why, this focused and hard hitting book talks of exactly how the country's tremendous resource of people power can be mobilized to conserve and to benefit from biodiversity.

This alternative is remarkable for the manner in which it seeks to harness the country's strengths in traditional sciences and customs, modern science and technology, trained manpower, as well as its democratic system of government, in order to emerge with an exciting strategy for equity based economic growth along with the conservation of biodiversity.

About the Authors

Madhav Gadgil *(to the left)* and P.R. Seshagiri Rao are ecologists who are deeply involved in understanding how people view and manage natural resources. Madhav Gadgil has degrees in biology from Pune, Mumbai and Harvard Universities; Seshagiri Rao, in agricultural sciences from Bangalore. Their research interests span over mathematical ecology, conservation biology, human ecology and ecological history. They have also been active in natural resource management policy studies. Madhav Gadgil has been a member of the steering committees of Project Tiger and Indian Board for Wildlife, Chairman of the Fuel and Fodder Study Group of the Planning Commission, Biodiversity Task Force of the Department of Biotechnology and Expert Group on Eastern and Western Ghats of the Ministry of Environment and Forests. He has been a member of the Silent Valley Committee, the Bastar Pine Plantation Committee and the Scientific Advisory Council to the Prime Minister. Currently he chairs the Science and Technology Advisory Panel to the Global Environment Facility.